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FINAL DECISION DOCUMENT STUDY AREA 17 WITH TRANSMITTAL NTC ORLANDO FL
4/18/2012
TETRA TECH

TETRA TECH

April 18, 2012

BRAC PMO Southeast
ATTN: Mr. Art Sanford
4130 Faber Place Drive, Suite 202
North Charleston, SC 29405

Reference: CLEAN Contract No. N62467-04-D-0055
Contract Task Order No. 0125

Subject: Final Decision Document for Study Area 17
Naval Training Center, Orlando, Florida

Dear Mr. Sanford:

Please find enclosed the signed Final Decision Document for Study Area 17 at NTC Orlando on CD for your use. Also enclosed for addition to the previously distributed hardcopy version of the SA 17 Decision Document are the signed certification page, signed Declaration (page 6-1), and a replacement spine for the binder.

If you have any questions, please contact me at (865) 220-4701.

Sincerely,

Teresa K. Grayson

Teresa K. Grayson
Task Order Manager

Enclosure

c:
Mr. David Grabka, FDEP
Mr. Mark Davidson, BRAC PMO SE
Mr. Allan Jenkins, Tetra Tech
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Comprehensive **L**ong-term **E**nvironmental **A**ction **N**avy

CONTRACT NUMBER N62467-04-D-0055

Rev. 0
03/26/12

Decision Document
for
Study Area 17

Naval Training Center
Orlando, Florida

Contract Task Order 0125

March 2012

BRAC Program Management Office Southeast
4130 Faber Place Drive, Suite 202
North Charleston, South Carolina 29405

TETRA TECH

DECISION DOCUMENT
FOR
STUDY AREA 17

FORMER NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Department of the Navy
Base Realignment and Closure
Program Management Office Southeast
4130 Faber Place Drive
North Charleston, South Carolina 29405

Submitted by:
Tetra Tech
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Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 0125

March 2012

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PROFESSIONAL GEOLOGIST CERTIFICATION

I hereby certify that this document, *Decision Document for Study Area 17*, was prepared under my direct supervision in accordance with acceptable standards of geological practice.

Allan T. Jenkins 4/2/12

Allan T. Jenkins, P.G. / Date
License No. PG-0000663

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ACRONYMS

ABB-ES	ABB Environmental Services
AFB	Air Force Base
amsl	Above mean sea level
AST	Aboveground storage tank
bgs	Below ground surface
BRAC	Base Realignment and Closure Act of 1990
CCI	CH2M Hill Constructors, Inc.
cis-DCE	Cis-1,2-dichloroethene
City	City of Orlando
COC	Chemical of concern
CPT	Cone penetrometer testing
CSM	Conceptual site model
CVOC	Chlorinated volatile organic compound
DET	Environmental Detachment
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
DPDO	Defense Property Disposal Office
DPT	Direct push technology
DRMO	Defense Reutilization and Marketing Office
EBS	Environmental Baseline Survey
EOS®	Emulsified oil substrate
ERD	Enhanced reductive dechlorination
ESS	Environmental Site Screening
FDEP	Florida Department of Environmental Protection
FFS	Focused Feasibility Study
FOSET	Finding of Suitability for Early Transfer
GCTL	Groundwater Cleanup Target Level
GOAA	Greater Orlando Airport Authority
HLA	Harding Lawson Associates
IAS	Initial Assessment Study
IC	Institutional control
IM	Interim Measure
IRA	Interim Remedial Action
ISCO	In situ chemical oxidation
lbs	Pounds

LTM	Long-term monitoring
LUC	Land use control
MIP	Membrane interphase probe
MNA	Monitored natural attenuation
NADC	Natural attenuation default source concentration
Navy	United States Navy
NTC	Naval Training Center
OPT	Orlando Partnering Team
ORP	Oxidation-reduction potential
PAH	Polynuclear aromatic hydrocarbon
PCR	Polymerase chain reaction
PLFA	Phospholipid fatty acids
POC	Point of compliance
RAB	Restoration advisory board
RAO	Remedial Action Objective
RBC	Risk-based concentration
SA	Study Area
SCTL	Soil Cleanup Target Level
TCE	Trichloroethene
TOC	Total organic carbon
TOR	Time of Remediation
TOS	Time of Stabilization
Tetra Tech	Tetra Tech NUS, Inc.
TTZ	Target Treatment Zone
µg/L	Micrograms per liter
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VC	Vinyl chloride
VOC	Volatile organic compound

1.0 INTRODUCTION

Environmental investigations have been conducted and interim remedial actions implemented for Study Area (SA) 17 at the McCoy Annex of the former Naval Training Center (NTC) Orlando, Florida. The results of investigations and the actions selected by the Orlando Partnering Team (OPT) to clean up environmental contamination associated with the site are described in this Decision Document. The OPT, which was assembled to address environmental issues at NTC Orlando, consists of representatives from the United States Navy (Navy) and its contractors, the Florida Department of Environmental Protection (FDEP), and the United States Environmental Protection Agency (USEPA). SA 17 was transferred to the City of Orlando (City) for commercial or industrial use through the Early Transfer Process in April 2008.

1.1 SITE BACKGROUND

The McCoy Annex is one of four facilities that comprised the former NTC Orlando (Figure 1). The other three facilities are Main Base, Area C, and Herndon Annex. The McCoy Annex is located approximately eight miles south of the Main Base, west of the Orlando International Airport. The history of the area known today as the McCoy Annex dates to 1941 with the construction of the Orlando Municipal Airport No. 2, in Pinecastle, Florida. Before construction of the airport, the property consisted of undeveloped land and wetlands that were owned by individual property owners until acquired by the City for construction of the airport. McCoy Annex was leased to the United States Army Air Corps from 1942 until the end of World War II and was known as Pinecastle Army Air Field. At the end of World War II, the base was deactivated and the property returned to the City.

When the Korean Conflict began in 1952, the base was reopened as the Pinecastle Air Force Base (AFB), subsequently renamed McCoy AFB in May of 1958, and was operated by the United States Air Force (USAF) until its closure in 1973. At that time, the Navy acquired title to part of the property that served as a community support annex for NTC Orlando and changed the name to McCoy Annex. The majority of the AFB, including runways, aircraft hangars, and maintenance facilities previously used by the USAF was not acquired by the Navy; that property is currently owned by the City and operated by Greater Orlando Airport Authority (GOAA) as the Orlando International Airport. NTC Orlando was closed in April 1999 as part of the Defense Base Realignment and Closure (BRAC) Act of 1990.

1.2 SITE DESCRIPTION

SA 17 occupies approximately 9 acres in the central part of the McCoy Annex (Figure 2) and was used for motor pool storage and maintenance, warehousing, and includes the area of the former Defense Property Disposal Office (DPDO). Figure 3 shows buildings and other major site features associated with

SA 17. The site Buildings included 7141, 7178, 7190, 7191, and 7193, all of which have been removed except 7141. The northwestern quarter of SA 17 (Buildings 7178, 7191, and 7193 and surrounding area) was used as the DPDO until about 1985 when the Defense Reutilization and Marketing Office (DRMO) was opened at Area C, NTC Orlando. The DPDO stored hazardous materials (e.g., paint, oil, antifreeze) at the site. The southwestern portion of the site is undeveloped. The entire southeastern portion of the site, including the former motor pool area where the highest levels of groundwater contamination have been encountered, consists of a soil and grass covered area that was formerly used by the motor pool. A shallow ditch extends along the entire southern boundary of the site and drains eastward. A summary of the use and activity of the former site buildings is provided below.

Facility 7141, located south of the drainage ditch along Ammons Avenue, was first constructed in 1973 as a manual chlorination station for city water piped into the McCoy Annex. The facility was replaced in 1991.

Building 7178 was constructed in 1965 as the Training Materials Storage Building, and encompassed 3,300-square feet. It had concrete block walls on a slab foundation. The asphalt pavement around the building was deteriorated and completely surrounded by a fence. A shed along the northwestern wall of the building was used for the storage of drums and flammable and/or hazardous materials. In 1994, a 110-gallon aboveground storage tank (AST) used for the storage of heating oil was removed from the building [ABB Environmental Services (ABB-ES), 1994].

Building 7190 was constructed in 1952 as an administrative building housing an Army Maintenance Office. The 3,000-square foot building was a concrete block structure that supported light automotive maintenance. A 550-gallon underground storage tank (UST) that was used for heating oil was removed from the building in March 1993. Associated with Building 7190 is a fenced compound that formerly served as a motor pool area. The compound is unpaved and covered by gravel, and was used by the base lawn maintenance contractor for equipment storage and maintenance. During the Environmental Baseline Survey (EBS), several 55-gallon drums of waste fuel, oil, and ethylene glycol were observed on wooden pallets along the northern fence line of the compound (ABB-ES, 1994). Hazardous materials (paints, oils, anti-freeze) were also reportedly stored here. These have since been removed [Harding Lawson Associates (HLA), 1999]. A vehicle wash rack that was located just outside the northern fence line of the storage area was reportedly connected to a leach field south of the wash rack inside the fenced storage yard (HLA, 1999). The building sustained substantial damage from heavy equipment in November 2007 due to vandalism.

Building 7191 was constructed in 1955 and was used for furniture storage. This 3,072-square foot building was constructed of concrete block walls on a slab foundation. A 110-gallon UST that held heating oil was removed sometime in the past. The fenced gravel lot between Buildings 7178 and 7191 was also used by the base lawn maintenance contractor to store equipment.

Building 7193 was constructed in 1959, had a concrete slab floor with metal frame walls, and encompassed 3,320 square feet. The building was bordered by a fenced paved lot on three sides. An earlier investigation reported that a 110-gallon UST and a 250-gallon AST were located within the adjacent DPDO area. Electrical transformers and 55-gallon drums with unknown contents may have been stored in this area (HLA, 1999).

The open area located immediately south of Building 7193 was designated in the Initial Assessment Study (IAS) as Site 6. A verification study for Site 6 was performed in 1986 (HLA, 1999). Drums were stored in this area as recently as March 1994.

1.3 SITE GEOLOGY

Multiple drill holes were installed and cone penetrometer testing (CPT) was conducted during the early stages of the site screening investigation to characterize the subsurface geology to depths of 65 feet below ground surface (bgs). The upper 30 feet of sediments consist primarily of fine sand with the exception of two thin (approximately 5 to 10 feet), discontinuous layers of silty sand. The upper layer of silty sand lies at about 10 to 15 feet bgs and appears to dip to the east and northeast. The lower layer of silty sand lies about 25 to 30 feet bgs and appears to be continuous across the site, but thins slightly to the north and east in the area investigated. The groundwater chemistry investigation results suggest that these silty layers act as sorptive zones and retard the downward flow of contaminants.

Below the lower layer of silty sand is an interval of fine- to course-grained sand that extends from about 30 to 50 feet bgs. This interval is underlain by another silty-sand layer that extends from 50 to 65 feet bgs, which is in turn underlain by approximately 10 feet of sandy, silty clay. This clay is considered to be an aquitard and represents the bottom of the surficial aquifer. Due to their green color, these units are considered the upper part of the Hawthorn Group of sediments. The clay is underlain by fine- to coarse-grained sand of the Hawthorn Group.

1.4 SITE HYDROGEOLOGY

The hydrogeology of the surficial aquifer of interest at SA 17 has been investigated by installing and monitoring wells at the site. The water table lies at a depth of three to six feet bgs across the site. The surficial aquifer extends to a depth of about 55 feet and the uppermost Hawthorn clay layer defines its lower extent. Figure 4 provides a well depth schematic that demonstrates the relationships of the wells and the nomenclature used to distinguish the aquifer depth intervals at SA 17. Monitoring well designators A, B, C, and D indicate the depth of the well and typically correspond to depths of less than 14, 15 to 30, greater than 30, and greater than 60 feet, respectively. For the remainder of this document, monitoring wells will be referred to with an abbreviated notation; for example, the designation for monitoring well OLD-17-04A will be shortened to 04A. It should be noted that wells 25C and 28C were installed at depths consistent with the D aquifer zone, and well 49D was installed at a depth that is consistent with the lower portion of the C aquifer zone; these conclusions are supported by groundwater elevations as discussed below. Also, some wells were destroyed during site activities and replaced, and are indicated by an “R” in the well designation.

Water levels have been monitored throughout the history of site investigations and groundwater remediation and monitoring at SA 17. The data show consistent and similar groundwater elevations for the A, B, and C aquifer zones across the site; a seasonal variation of two to four feet has been observed. For clustered well locations, the C wells typically have a slightly lower groundwater elevation (i.e., generally less than 0.5 feet) indicating a downward vertical gradient from the shallow to the deeper portion of the surficial aquifer. Overall, the groundwater elevation data suggest predominantly horizontal flow in the surficial aquifer. Wells completed below the clay-rich zone of the Hawthorn Group, i.e., certain C and D wells, consistently show groundwater elevations that are 25 to 30 feet lower than the shallower wells, indicating a strong vertical gradient across the upper Hawthorn sediments. The large difference in water levels between the surficial aquifer and the wells completed below the Hawthorn clay zone are indicative of the low permeability of the clay-rich sediments and suggest a poor hydraulic communication between these two groundwater units that lie above and below the clay, respectively.

The groundwater elevation data from water levels recorded in March 2010 are presented as potentiometric surface maps for aquifer Zones A through D in Figures 5 through 8, respectively. The groundwater elevation contours shown on these figures are typical for the site and are representative of current conditions. Groundwater elevation contours based on the Zone A well data indicate that shallow groundwater flow across most of SA 17 is southward toward the ditch that runs along the southern portion of the site. Groundwater in Zone B shows a groundwater flow pattern similar the Zone A, with a southward flow toward the ditch. The ground surface elevation recorded for wells located in and along the ditch is approximately 85 feet above mean sea level (amsl), which is lower than the groundwater elevation frequently observed in both A and B Zone wells (i.e. 86 feet or greater). This difference in elevation suggests that the groundwater may discharge to the ditch and explains the localized southeastern flow direction in the A and B aquifer zones. Groundwater elevation contours for Zone C depict an easterly flow direction near the central portion of the site that becomes northeasterly downgradient. Although the groundwater elevation in Zone C wells is also higher than the elevation of the ditch, it does not appear that groundwater in Zone C flows directly toward the ditch; flow in the C Zone appears to be influenced by a more regional flow system. The groundwater elevations in Zone D, below the Hawthorn clay, also show a general groundwater flow direction to the east that is likely consistent with a more regional flow regime.

The groundwater flow velocity for the various aquifer zones at SA 17 has been computed and presented in previous investigation and remedial action plans and reports. Slug tests conducted in several wells during the initial site investigation (HLA, 1999) were used to estimate the aquifer hydraulic conductivity. This data along with typical site hydraulic gradients and effective porosity estimates based on site lithology were used to estimate a groundwater flow velocity range of about three to seven feet per year, thus indicating a slow rate of groundwater (and contaminant) movement for all aquifer zones at SA 17. A pump test conducted in 2005 [CH2M Hill Constructors, Inc. (CCI)] showed hydraulic conductivity estimates for the B and C aquifer zones that were significantly greater than the slug test results. A recalculation of the groundwater flow velocity based on the pump test data results in a groundwater velocity range of 34 and 20 feet per year for the B and C aquifer zones, respectively.

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2.0 SUMMARY OF INVESTIGATIONS

A series of environmental studies and actions have been conducted at SA 17. They include investigation and monitoring events, a soil removal interim remedial action (IRA), and two separate groundwater IRAs in the source area near the center of the site. The table below provides a summary of actions and events conducted at the site.

Table 1
Chronological Summary of Environmental Activities
Study Area 17
Naval Training Center
Orlando, Florida

Active Use Of The Site	
1941 to 1945	United States Army Air Corps
1945 to 1952	Leased to City
1952 to 1973	USAF
1973 to 1999	Navy
Environmental Baseline Survey (ABB-ES)	
December 1994	Submittal of EBS Report
Initial Site Screening (ABB-ES)	
February through May 1995	A geophysics survey, passive soil gas survey, surface and subsurface soil sampling, were conducted. In addition, the surface water and sediment of the drainage ditch were sampled. Wells 01A through 05A and 24T were installed and sampled.
October through November 1996	A polynuclear aromatic hydrocarbon (PAH) evaluation was performed for soil using field immunoassay analysis.
Supplemental Site Screening (HLA)	
January through February 1997	During Phase I, monitoring wells 06 through 10 were installed and sampled.
November 1997	Confirmatory soil sampling for PAHs was performed.
March through April 1998	CPT was conducted at nine locations to evaluate subsurface lithology, and direct push technology (DPT) groundwater sampling was performed at 31 locations. Nine piezometers were installed in the surficial aquifer. A soil vapor headspace survey was performed at 20 locations, with two samples analyzed at the laboratory.
April through August 1998	Phase II of the supplemental site screening was performed. HLA personnel installed and sampled monitoring wells 11 through 28 and drive points 29A through 33A.
Soil IRA [Environmental Detachment Charleston (DET)]	
May 1999	DET completed surface soil excavation to remove PAH and arsenic-contaminated soil.
Groundwater In situ chemical oxidation (ISCO) IRA in Source Area (CCI)	
February 2000	Phase I confirmation sampling was performed. Fourteen monitoring wells were resampled.
March through April 2000, August 2000	Phase II confirmation sampling was performed. Work included DPT groundwater sampling at locations 1 through 20. Monitoring wells 34 through 37 were installed. Monitoring wells 23A and 24B were replaced.
October 2000	CCI collected basis of comparison groundwater samples from three shallow injection wells, nine intermediate injection wells, eight deep injection wells, and two monitoring wells.
November 2000 through January 2001	Phase I-A IRA injection was performed using ISCO in shallow, intermediate, and deep zones. Post-injection samples were collected. Phase I-B IRA injection was performed. Eight deep injection wells were installed and ISCO was conducted in deep zone.

January through February 2001	Post-injection sampling was performed.
May through June 2001	CCI collected groundwater samples from seven very deep injection wells. Very deep injection wells 39 through 48 were installed. DPT groundwater sampling was performed at locations 21 through 35. Very deep injection wells 51 through 76 were installed.
March 2002, August 2002, and September 2002	Phase II IRA injection was performed by conducting ISCO in the very deep zone. Intermediate and deep zones were given polishing treatment.
July 2002, October 2002, January 2003, and June 2003	Performance evaluation groundwater monitoring was conducted.
Site Investigation Tetra Tech	
August 2002	DPT groundwater samples were collected at locations P100 through P121. Monitoring wells OLD-17-38 through OLD-17-45 were installed.
September 2002	Groundwater samples were collected.
November 2002	DPT groundwater sampling was conducted at locations P122, P123, P126, and P128 through 130. Monitoring wells OLD-17-46 through OLD-17-51 were installed.
December 2002	Groundwater samples were collected.
Source Area Investigation and Focused Feasibility Study (FFS) (CCI)	
August 2003	48 membrane interface probe (MIP) borings were installed to depths of 50 feet and 28 groundwater samples were collected.
October 2003	An additional 28 DPT samples were collected. Ten soil borings were installed.
Groundwater Sampling (CCI)	
August 2004 and March 2005	Groundwater samples were collected to obtain current site groundwater conditions.
Optimization Study	
February 2005	An Optimization Study of the site was completed. Emulsified Oil Substrate (EOS®) injection was recommended along with recirculation of treated groundwater.
Groundwater EOS IRA in Source Area (CCI)	
August 2006	EOS® treatment began using 12 injection wells. Contaminated groundwater was extracted from two extraction wells. The extracted water was re-injected through the 12 injection wells along with EOS®.
Post-IRA Phase I Monitoring (CCI)	
September 2007, December 2007, and July 2008	Post-remedial groundwater monitoring was conducted.
Groundwater IRA Polishing Treatment (CCI)	
October 2008	Polishing injections of EOS® were performed at two shallow zone (B zone) locations within the shallow aquifer.
Post-IRA Phase II Monitoring (CCI)	
December 2008, March 2009, and September 2009	Groundwater monitoring was conducted at selected wells
Long Term Monitoring	
September 2007	Sampled all site monitoring wells to determine sampling program.
December 2007	Began semi-annual sampling program.

2.1 INITIAL SITE SCREENING (1995 TO 1996)

Between February 1995 and November 1996, initial site screening was conducted. Investigators performed a geophysics survey, collected soil gas samples, installed monitoring wells, and collected surface and subsurface soil, groundwater, surface water, and sediment samples (ABB-ES, 1995). The significant findings of the initial site screening included groundwater concentrations of trichloroethene (TCE), cis-1,2-dichloroethene (cis-DCE), and vinyl chloride (VC) greater than their respective FDEP Groundwater Cleanup Target Levels (GCTLs) (FDEP, 1999). Surface and subsurface soil were found to contain concentrations of PAHs at concentrations greater than their respective FDEP industrial Soil Cleanup Target Levels (SCTLs) (FDEP, 1999).

2.2 SUPPLEMENTAL SITE SCREENING (1997-1998)

From January 1997 to August 1998, HLA performed a supplemental site screening in two phases to evaluate groundwater conditions further. Chlorinated volatile organic compounds (CVOCs) were found at depths ranging from approximately 5 to 60 feet bgs. The work performed is described in the BRAC Environmental Site Screening Report, Study Area 17, Naval Training Center Orlando, Florida (HLA, 1999).

Phase I results established that the CVOC plume extended over a significant area, and a more extensive field program was designed and implemented to determine the nature and extent of the groundwater contamination. Phase II investigation activities involved DPT groundwater sampling and CPT to characterize the subsurface lithology across the site. A total of 185 groundwater samples were collected from 31 DPT locations and analyzed at an on-site field analytical laboratory. Based on the results, additional monitoring wells were installed at various depths. Several of the new wells were incorporated with existing wells to form well clusters, with each cluster containing a shallow (A), intermediate (B), and deep (C) monitoring well. Groundwater sampling indicated cis-DCE, VC, and TCE concentrations exceeded their respective GCTLs.

2.3 SOIL IRA (1999)

During 1999, a soil IRA was performed to remediate surface soil concentrations of arsenic and PAHs that exceeded the State of Florida industrial/commercial SCTLs that were in use at that time. In May 1999, surface soil was excavated to a depth of two feet across an area of approximately 300 by 100 feet. PAH-contaminated surface soil was mitigated to levels compatible with future non-residential land use.

2.4 GROUNDWATER ISCO IRA (2000)

In 2000, a groundwater IRA was performed by CCI in an attempt to reduce CVOC concentrations in the source area groundwater. This IRA included ISCO using the patented Geo-Cleanse® process. The process included injecting hydrogen peroxide and trace quantities of metallic salts under pressure into the subsurface to destroy organic contaminants in the soil and groundwater. The end products of CVOC oxidation are primarily carbon dioxide and water, with trace amounts of chloride. Unconsumed hydrogen peroxide naturally degrades to oxygen and water within a few days of injection. Success of the process is highly dependent upon delivery and distribution of the oxidant and direct contact with the contaminant.

ISCO injections at SA 17 were completed in two phases. Phase I consisted of two injection events conducted from November 2000 through January 2001 during which a total of 6,307 gallons of 50 percent hydrogen peroxide solution was injected into three vertical zones via 69 injectors with screen intervals ranging from 10 to 25 feet bgs. At the time of this IRA event, it was believed that the bulk of source area contamination was located within 25 feet bgs.

Prior to beginning Phase II, additional injection wells were installed with screen intervals below 25 feet bgs. Phase II consisted of three injection events conducted in March, August, and September 2002 during which a total of 13,923 gallons of 50-percent hydrogen peroxide solution was injected into the aquifer. Following completion of Phase II, groundwater sampling and analysis indicated that TCE and CVOC concentrations were reduced dramatically, by approximately 88 percent compared to baseline conditions. A summary of the field activities and findings from each phase are provided in the Construction Documentation Report for the IRA at SA 17 (CCI, 2003).

2.5 SITE INVESTIGATION (2002)

A limited site investigation was performed by Tetra Tech between August and November 2002 to define the lateral and vertical extent of CVOC contamination in groundwater and a Site Investigation Report was submitted to FDEP (Tetra Tech, 2004). The focus of this investigation was to fill data gaps in the intermediate and deep portions of the surficial aquifer (i.e., just above and below the lower silty sand layer) down gradient of the source areas. In August 2002, 22 DPT groundwater samples were collected and analyzed for volatile organic compounds (VOCs). Eight monitoring wells were installed at various depths, and six of these wells were sampled in September 2002.

An additional six locations were sampled using DPT in November 2002 to confirm the down gradient extent of the plume. Based on these results, six additional monitoring wells were installed as three “C” and “D” well pairs in November 2002. Groundwater samples were collected again in December 2002. These results confirmed the lateral and vertical extent of groundwater contamination at SA 17 in late 2002.

2.6 SOURCE AREA INVESTIGATION AND FOCUSED FEASIBILITY STUDY

Work in 2003 included a source area investigation and FFS completed by CCI (2004). The purpose of the source area investigation was to evaluate the distribution of CVOCs in soil and groundwater at SA 17, specifically those areas with relatively very high concentrations of TCE in groundwater. Three main sampling efforts were conducted during the source area investigation: a MIP investigation; DPT groundwater sampling; and DPT soil sampling. After an initial decrease in CVOC concentrations after the ISCO treatments in 2000, an increase in concentration levels was seen in the source area groundwater. Investigators concluded that the rebound of contaminants in groundwater after the IRA was due to high levels of TCE located in less permeable zones of the aquifer that were not destroyed by the ISCO applications. Sampling results from this investigation showed an area of approximately 50-feet by 50-feet by 40-feet deep contained the highest levels of soil and groundwater contaminants that were determined to be the source of groundwater contamination. As a result, this area was identified in the FFS as the target treatment zone for further IRA work.

The remedial action objective (RAO) selected in the FFS was to minimize continuing leaching of source contamination from the impacted soil to the groundwater and to obtain a target cleanup level of 500 micrograms per liter (ug/L) of total CVOCs in groundwater. Three remedial alternatives were evaluated in the FFS: excavation of contaminated soil in the source area; in situ chemical oxidation of source area; and enhanced in situ bioremediation of the source area. The cost analysis indicated that soil excavation was the most expensive alternative with in situ chemical oxidation and in situ enhanced bioremediation at similar cost levels (one half to one third of excavation costs).

2.7 GROUNDWATER NATURAL ATTENUATION MONITORING (2004-2005)

In 2004 and 2005, extensive groundwater sampling was used to assess the status of CVOC contamination and to evaluate natural attenuation of the plume. Work included sampling 50 wells for CVOCs, dissolved oxygen (DO), oxidation reduction potential (ORP), and pH. Thirty-six wells were sampled for sulfate, dissolved iron, dissolved manganese, alkalinity, and sulfide. Methane was analyzed in 30 samples and nitrate was analyzed in 25 samples. Thirteen samples targeted for monitored natural attenuation (MNA) analyses were also sampled for hydrogen. Six wells were sampled for phospholipid fatty acids (PLFA) and Real-Time polymerase chain reaction (PCR) analysis to assess the microbial populations. Water elevation data were also collected to determine groundwater gradients. Analytical results showed conditions amenable for natural attenuation and provided evidence of reductive dechlorination. Reducing bacteria, Dehalococcoides, was verified at two locations and provided evidence that native bacterium capable of effectively degrading CVOCs were present. The data also suggested that plume stability had been reached, and that biostimulation would be effective to accelerate the natural reductive dechlorination of the CVOCs (CCI, 2005a).

2.8 OPTIMIZATION STUDY (2005)

In 2005, an optimization study was completed for the site by CCI to optimize the remedy selection process. The Optimization Report (CCI, 2005b) presented the following: site background and current conditions, discussion of uncertainty, identified target treatment areas, specified RAOs and performance objectives, a review of focused alternatives previously evaluated (CCI, 2004), and a recommendation for future action. A comprehensive summary of the Conceptual Site Model and the results of two modeling efforts to estimate the Time of Remediation (TOR) and Time of Stabilization (TOS) were also presented in the Optimization Report. The TOR estimates the timeframe required to achieve a target cleanup goal for groundwater (i.e., 5 µg/L was used) in the contamination source area. The TOS estimates the timeframe required to achieve a target concentration in groundwater at a fixed distance downgradient of the source area (i.e., plume stabilization).

The TOR evaluation was performed using a range of pounds (lbs) for the source area mass (± 50 percent of the 93 lbs source area estimate) and a range of source mass removal percentages (six increments from 0 to 95 percent). A key finding for the TOR evaluation was that none of the modeled scenarios showed an appreciable reduction in the TOR estimate (all modeled scenarios including 95 percent removal required 60 to 64 years); in other words, only if the implemented remedial action resulted in nearly complete removal of source mass would it be successful in mitigating the dissolved plume. Because complete, or nearly complete (greater than 95 percent) source mass removal (or destruction) is difficult to achieve under field conditions, the TOR study suggested that remedial efforts that focused on source removal/destruction would not be cost effective – that a plume would continue to exist and require monitoring, or possibly treatment, even after source removal/destruction had been performed.

The TOS evaluation was performed using a range of source area concentrations and a range of downgradient distances for the point of compliance (POC). The target goal for CVOCs in groundwater at the POC well was 5 µg/L, similar to the TOR study. The model incorporated reductive dechlorination of CVOCs based on the utilization of iron in the aquifer as the terminal electron process, consistent with the findings of natural attenuation monitoring conducted at the site (CCI, 2005a). The average TOS for all modeled scenarios ranged from 44 to 141 years; however, all scenarios indicated that the target goal of 5 µg/L in groundwater would be achieved no more than 300 feet downgradient of the source area.

On the basis of the above evaluations and site conditions at the time of the report, the modeling study concluded the following:

- Further source reduction results in limited reduction in long term monitoring requirements of site and no measureable increased protection of human health and the environment.

- Given the SA 17 source area is approximately 600 feet from the property boundary (facility boundary); the model results indicate that the source will not cause an offsite groundwater concentration to exceed GCLTs at any point in the future.

- Given the current distribution of contaminants (as of February 2005), no location downgradient of the source area at SA 17 is anticipated to yield an offsite exceedance of GCTLs at some point in the future.

The Optimization Report recognized that a substantial effort to treat the source area for groundwater contamination had been completed [i.e., ISCO of the source area (CCI, 2003)]. Based on post-ISCO monitoring results (CCI, 2004, 2005a) and the modeling study summarized above, it was believed that the "practical limits of cost effective remediation for the purposes of complete removal of the source have been exhausted". Based on these conclusions, "achieving a pre-determined source mass reduction or concentration reduction is not a component of the recommended RAO" for SA 17. The identified RAO was to implement a remedial alternative that would manage the source area to prevent further contaminant migration away from the source and recontamination of the zone already treated by the ISCO IRA. Based on a meeting between the NAVY and CCI, two remedial alternatives were described in the Optimization Report: 1) Excavation as a means of comprehensive source removal, and 2) Enhanced Reductive Dechlorination (ERD) using EOS® to degrade contaminants leached from the source area into groundwater. The alternatives were evaluated on the basis of effectiveness, implementability, uncertainty, and cost. An alternative consisting of injection of EOS® in the source area with recirculation of treated groundwater, installation of wells at key locations, continued monitoring, and risk assessment was recommend for SA 17.

2.9 EOS IRA (2006-2008)

During the period August-September 2006, the recommendations of the Optimization Study were implemented as an IRA for the targeted contamination source area near the center of the SA 17 site. EOS® was injected into and recirculated in the aquifer within the Target Treatment Zone (TTZ [CCI, 2006]). EOS® is a patented substrate that consists of emulsified soybean oil, with oil droplets small enough to pass through most pores in the soil. EOS® was chosen because it is a long-lasting substrate that facilitates microbial growth in the subsurface over an extended period by providing a source of energy from which microbial populations can multiply and degrade chlorinated solvents. The goal of the EOS® injection was to provide a long term (i.e., one year or more) substrate to support the growth of microbes capable of performing reductive dechlorination. During ERD, microbes ferment a carbon source (emulsified oil, the electron donor) to produce hydrogen which is in turn used by microbes to obtain energy via chemical transformation of available CVOCs (electron acceptors). Under favorable conditions, this process leads to successive chemical reactions beginning with breakdown of the parent CVOC (TCE at SA 17) to daughter products (e.g., cis-DCE, VC, ethene) and subsequent breakdown of the daughter products to carbon dioxide and water.

Six pairs of injection wells (screened in the B and C zones) were installed around the perimeter of the TTZ and one pair of extraction wells was installed at the center of the TTZ. A total of over 12,000 gallons of diluted EOS® solution was injected into aquifer Zones B and C to promote reductive dechlorination of contaminants in the TTZ. The EOS was injected at two depths (B and C aquifer zones) using the paired injection wells at six locations around the perimeter of the TTZ. Approximately 2400 gallons of EOS® solution were injected into B zone wells while C zone wells received approximately 9800 gallons of EOS® solution. The pair of extraction wells placed in the center of the TTZ was used to withdraw groundwater simultaneously with the injection, thus creating an inward hydraulic gradient to induce distribution of the EOS®. Water chemistry amendments were included during the EOS® injection to support achievement of a more favorable pH for microbial growth (optimal target pH of 7.0). Additional monitoring wells were installed within the TTZ to aid evaluation of the effectiveness of the EOS IRA.

2.9.1 EOS® Evaluation (June 2006 through July 2007)

IRA baseline groundwater sample collection was conducted in June 2006 prior to the EOS injection events. Following the EOS® injection, four rounds of post-injection quarterly monitoring were conducted during October 2007, January 2007, April 2007, and July 2007. The evaluation of the ERD treatment progress was presented in a Technical Memorandum (CCI, 2010). Overall, the data suggested that EOS® had not been effective in the B zone of the aquifer. Most B zone wells showed little to no decrease in TCE concentrations. TOC was not observed to increase and the geochemical indicator parameters did not suggest that reductive conditions had been enhanced in the B zone of the aquifer. The observations led to a conclusion that certain parts of Zone B target area failed to receive substrate distribution.

In the C zone wells, high TOC and reducing conditions were established and maintained throughout the 1-year post-injection monitoring phase. These observations indicated that the EOS® was distributed, persisted in the subsurface, and continued to provide a source of organic carbon for more than a year. Detection of sulfate-reducing and methanogenic conditions also provided evidence of low ORP conditions conducive to ERD of CVOCs. A significant decrease of TCE was observed in the majority of the Zone C wells.

2.9.2 Additional EOS® Treatment for Groundwater

Because of the limited success of the August-September 2006 EOS® treatment in aquifer zone B, two Zone B locations were selected to receive polishing injections of EOS® in October 2008. Approximately 850 gallons of 6 percent EOS® solution were injected with the goal of enhancing the ERD process in aquifer Zone B. To address the acidic conditions in the aquifer, a pH buffer solution was also injected. The effectiveness of the treatment was evaluated by sampling wells located in and around the TTZ. Subsequent sampling conducted during September 2009 indicated near-complete reduction of TCE at these locations with significant VC and measurable ethane production in the aquifer. Methanogenesis was evidenced by increasing methane concentrations in both areas. The polishing injections were deemed successful in promoting ERD.

2.9.3 Lessons Learned

Based on the trend of contaminant concentrations observed after the 2006 EOS® injections, it is evident that the injection was initially more successful for the deeper Zone C than in the shallower B zone within the treatment area. One of the factors prevalent in the aquifer at SA 17 that may be inhibiting a robust ERD is low pH of the groundwater. The ambient pH of groundwater at the site is in the acidic range with an average pH between 4.9 and 6.1. A low groundwater pH is a known factor capable of limiting the growth of microbes responsible for ERD. The persistence of cis-DCE and the absence of significant concentrations of VC in some of the wells may be indicative of microbial stress. Microbial populations seem to be impacted by the acidic nature of the groundwater (CCI, 2010). As indicated by additional pH enhancement during the 2008 polishing event for Zone B, pH buffering appears to facilitate the microbial population and thereby enhance the ERD process.

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3.0 CURRENT CONDITIONS

Groundwater monitoring was conducted quarterly following the initial EOS injection in late 2006 and has been conducted semiannually since the second groundwater IRA event occurred in late 2008. The monitoring has included water level measurements and groundwater sample analyses for the CVOCs of concern at the site. These data have been used to analyze the groundwater flow, to assess the relative strength of the source area contamination, and to delineate the dissolved groundwater plumes at the site. The most recent monitoring event for which data are available at the time of this report was conducted in October and November 2010.

3.1 GROUNDWATER AND CONTAMINANT FLOW

CVOCs have impacted the surficial aquifer at SA 17 that lies between approximately 6 and 55 feet bgs. The aquifer contains vertical heterogeneity in the lithology of the subsurface materials, ranging from sand to silty sand. Due to changes in the hydraulic properties of these layers, the surficial aquifer has been divided into three successively deeper zones (A, B, and C) that represent the major groundwater flow zones; these zones are separated by lower permeability materials (very fine, silty sand). Zone C is underlain by the upper Hawthorn clay zone (silty and clayey sand and clay) that represents the bottom of the surficial aquifer. Groundwater in another sand interval lying immediately below the clay zone is represented as Zone D. As noted above, wells 25C and 28C were installed at depths consistent with the D aquifer zone, and well 49D was installed at a depth that is consistent with the lower portion of the C aquifer zone.

Figures 5 through 8 introduced in Section 1.4 represent typical groundwater potentiometric conditions for SA 17. The groundwater flow direction for Zones A and B tends to be southward and appears to be influenced by groundwater discharge to the ditch along the southern portion of SA 17. Groundwater flow in Zone C is more eastward near the center of SA 17 and becomes northeastward where it crosses the original SA 17 site boundary, as confirmed by the potentiometric contours and by the shape and extension of the dissolved plume in that direction. Groundwater flow conditions indicate that groundwater moves downward through the surficial aquifer (Zones A to C) and that flow becomes predominantly horizontal in the C zone. Dissolved contaminants are leached from the contaminant source materials (i.e., low permeability layers that lie between Zones A and B and between Zones B and C near the center of the site) and transported downward and laterally downgradient predominantly in Zone C. The large difference in potentiometric elevation data between Zones A, B, and C compared to Zone D and the decrease in chemical of concern (COC) concentrations between Zones C and D indicate that the flux of groundwater and contaminants to the deeper aquifer zone below the Hawthorn clay is low.

3.2 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) for the site was presented in the *Optimization Report for Study Area 17* (CCI, 2005b) and the reader is referred to that report for a summary of the contamination source and release information; geologic and hydrologic information; contaminant distribution, fate, and transport; impacts of the first groundwater IRA event (i.e., ISCO in 2000, 2001, and 2002); and a description of then-current uncertainties associated with the site investigation data. Additional sampling data collected subsequent to publication of the CSM (February 2005) depict groundwater flow conditions, source area concentrations, and a dissolved plume that are consistent with the CSM. The additional data collection activities have also addressed specific uncertainties that were identified in the CSM at that time, as summarized below.

- Uncertainty #1: The southern extent of the groundwater plumes and their potential impact on shallow surface water in the ditch lying immediately south of the site was an uncertainty.

- Resolution #1: Samples of surface water were collected from the ditch in May 2005 (CCI, 2006) and no chemicals were detected greater than surface water cleanup target levels; thus it was determined that the groundwater plume is not impacting surface water.

- Uncertainty #2: The depth of contamination in groundwater directly beneath the source area where TCE contamination was greatest was not fully defined.

- Resolution #2: In May 2005, well 51C was installed in the TTZ with a screen interval depth of 42 to 47 feet bgs (CCI, 2008). A groundwater sample from this well showed a TCE concentration of 979 µg/L; this concentration was below 10,000 µg/L that had been used to define the source zone and provided evidence that dense non-aqueous phase liquid (DNAPL) was not present at this depth in the aquifer. This well was also used as a pumping well to conduct an aquifer test in the C zone.

A revised conceptual site model was prepared in 2010 and is included as Figure 9.

3.3 CONTAMINATION SOURCE AREA

Previous investigations and current groundwater sample results demonstrate that an approximately 50 by 50 feet area extending to a depth of up to approximately 50 feet bgs contains high concentrations of CVOCs that are a continuing source for dissolved groundwater contamination (see Sections 2.6 through 2.9). The source area was delineated and is shown in Figures 10 and 11 (CCI, 2005b). The mass of TCE present in the source area was estimated to be 93 pounds (see Sections 2.6 and 2.8). The concentrations of dissolved CVOCs in source area groundwater have fluctuated in response to the IRA aquifer treatment events conducted in 2000-2002, 2006, and 2008, but have shown an overall downward trend. The most recent groundwater sample results (Oct/Nov 2010) for wells in the source area (i.e., 53B/C through 58B/C) show maximum concentrations of COCs as follows: TCE = 974 µg/L; cis-DCE = 4,380 µg/L; and VC = 797 µg/L. However, the current concentration of TCE represents over an order of magnitude decrease in source area dissolved TCE concentration compared to historical high concentrations in these wells (well 53C1 = 47,300 µg/L TCE in June 2006). The downward trend in dissolved TCE concentration in the source area groundwater is attributed to the effects of enhanced biological stimulation of natural attenuation processes. Sustained high concentrations of cis-DCE and VC in the source area provide a direct line of evidence that TCE is being broken down by microbes into its chemical daughter products.

3.4 GROUNDWATER PLUME

Groundwater movement through and around the source area located near the center of SA 17 has created a plume of dissolved COCs in the surficial aquifer that extends downgradient of the source area. The primary COCs in the plume are TCE, cis-DCE, and VC, although some 1,1-DCE has also been detected . The approximate areal extent of the CVOC plume (area where one or more COCs exceeds GCTLs) as of March 2010 for aquifer Zones A though D is presented in Figures 12 through 15, respectively. Consistent with historical results, the current highest TCE concentrations are observed to be associated with source area wells in Zone C and the largest area of plume development for all CVOCs lies within the C zone of the aquifer (approximately 30 to 50 ft bgs). The following sections describe the current groundwater conditions in each of the aquifer layers.

The plumes within the A and B zones of the aquifer (maximum depth of about 30 feet bgs) are contained within the original site boundary of SA 17 and are relatively small with respect to the underlying plume in Zone C. The March 2011 data show that a TCE plume does not exist in Zone A and is of limited extent in Zone B with a maximum concentration of 10.7 ug/L. Zone A contained cis-DCE and VC at maximum concentrations of 31.3 and 88 ug/L, respectively; Zone B contained cis-DCE and VC at maximum concentrations of 322 and 186 ug/L, respectively. While the plume concentrations have historically varied within Zones A and B, the size and position of the plumes within these aquifer intervals has remained relatively consistent over time. These observations suggest that one or more conditions exist: 1) groundwater and COC migration is predominantly downward through aquifer Zones A and B, and/or 2) attenuation processes (natural and enhanced) have been successful in limiting plume development in these zones. These conditions have led to a stabilized and shrinking plume for aquifer Zones A and B.

The plume in the C zone of the aquifer is large with respect to Zones A and B and concentrations of the COCs are currently up to an order of magnitude higher. In addition, the plume in Zone C extends northeastward, beyond the original site boundary of SA 17 (but lies within the boundary of the NTC facility). The March 2011 data show maximum concentrations of TCE and cis-DCE in the source area at well 53C1 (2180 and 2820 ug/L, respectively), and a maximum concentration for VC downgradient at well 20C (906 ug/L) . There is a strong decreasing concentration gradient for TCE away from the source area (i.e., central portion of SA 17) and TCE is not observed within approximately 250 feet hydraulically down gradient of the source area. cis-DCE and VC are both present in the source area, but unlike TCE, both chemicals extend throughout the downgradient portion of the plume. Historically, downgradient monitoring well data have indicated that the leading edge of the plume has migrated approximately parallel with the NTC Facility Boundary and has not extended off the former Navy property. The most downgradient wells in the C zone (i.e., wells 48C and 49D) have shown an overall upward concentration trend through the 2009 sampling events. However, a significant decrease in concentrations was observed during both 2010 semiannual sampling events for well 48C and a leveling off of concentrations was observed for well 49D.

3.5 IRA IMPACTS ON SOURCE AREA

The ISCO and EOS IRAs implemented at SA-17 have achieved significant reductions in TCE concentrations in the source area groundwater. Source concentrations were greatly reduced following the 2000-2002 ISCO events; however, concentrations of TCE were observed to rebound. Following the EOS events in 2006 and 2008, an overall reduction in TCE concentrations in the source zone between one and two years after the injection event was observed (Table 2). However, a rebound in TCE concentrations was again observed in some monitoring wells (e.g., 53C, 54C, 55C) located in the source area. Numerous physical and chemical constraints may have contributed to rebounding concentrations. For example, site soil varies considerably with depth as indicated by well logs and zones of low-permeable soil likely represent diffusion-limited zones that cannot be readily penetrated by ISCO or EOS injections. Alternatively, insufficient oxidant may have been injected to destroy the total mass of contamination present, or changing geochemical conditions may not sustain microbes for a sufficient period of time to maintain control of the mass flux out of the low permeability materials in the source area. IRA monitoring indicates that additional treatment of the source zone will be necessary to control future contributions of dissolved contamination to the downgradient plume, which if not successful, could result in migration of contaminants beyond the NTC facility boundary.

Table 2
Summary of EOS® Treatment Results for TCE
Study Area 17

Well ID	June* 2006	Oct. 2006	Jan. 2007	April 2007	July, Sept. 2007	Dec. 2007	July 2008	Dec. 2008	March 2009	Sep.2 009	March 2010	Oct. 2010	March 2011	Percent Decrease Since Baseline
MW-53B1	307	139	49.5	16.1	22.7	1.61	0.86	<1	<1	<0.32	<1	**	**	99.7
MW-53B2	87.3	172	93.8	14.3	10.6	1.22	0.64	<1	<1	8.2	<1	**	**	99
MW-54B	230	1160	745	614	589	116	56.8	21.2	28.7	42.2	15.4	8.8	10.7	95.3
MW-55B	9100	7970	5100	5300	5820	**	**	**	**	2.7	1.2	**	**	99.9
MW-56B	8420	2910	1780	3200	6580	**	**	**	**	<1.6	<10	**	1.3	99.9
MW-57B	48.4	259	82.5	32	25.4	15.9	3.3	50.6	21.9	3.6	3.5	**	**	92.8
MW-58B	1100	215	157	138	60.2	**	**	**	**	**	**	**	**	94.5
MW-53C1	47300	3300	2320	1060	767	1290	846	2910	33900	4130	4380	21100	2180	95.4
MW-53C2	47100	3930	1390	673	284	135	110	463	6920	974	733	**	**	98.4
MW-54C	24200	4360	521	2560	2390	2200	**	**	**	10300	2480	**	**	89.8
MW-55C	4500	2080	1110	482	430	**	**	**	**	3710	3190	974	379	91.6
MW-56C	3320	423	355	254	181	**	**	**	**	30.4	22.5	**	**	99.3
MW-57C	387	423	145	145	86.4	187	74.2	14.5	14.1	5.6	8.2	**	**	97.9
MW-58C	4280	610	2320	2560	2100	**	**	**	**	**	**	**	**	50.9

All TCE concentrations are in micrograms per liter.
First EOS® injection – Zones B and C: August 2006.
Polishing EOS® Treatment - Zone B: Oct. 2008.
* Indicates baseline sample collected.
** Indicates no sample collected.

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4.0 SELECTED REMEDY

Contaminated surface soils at SA 17 that represented potential direct contact risk have been addressed by removal actions and no additional remedial measures are warranted for surface soil. Subsurface soil contamination (arsenic, PAHs) remains in localized areas beneath the former motor pool area of the site between a depth of 2 feet bgs and the water table (typically 6 feet bgs). Because the property was transferred to the City with LUCs, risk from direct contact with contaminated subsurface soil is mitigated by institutional control. Groundwater is the only site media that requires further remedial action. Based on these site conditions the remedial action objectives (RAOs) have been selected to protect human health and the environment from current and future risks resulting from exposure to contaminants present in groundwater. The following summarizes the RAOs for groundwater at the site:

- Prevent human ingestion of groundwater containing concentrations of COCs that exceed FDEP drinking water-based regulatory requirements or risk-based acceptable exposure levels.

- Gain control over migration of CVOCs in groundwater that may leave the source area and contribute to off-site exceedances of FDEP drinking water-based regulatory requirements or risk-based acceptable exposure levels.

- Prevent exposure via direct contact with subsurface soil contamination.

- Prevent exposure to contamination via vapor intrusion into occupied structures overlying or near the groundwater plume.

Two IRAs have been implemented to address the groundwater source area near the center of SA-17. The on-going IRA that utilizes injection of a carbon source to accomplish ERD has been observed to be effective in reducing concentrations of TCE in the contamination source area (near the center of SA 17). Because the success of ERD technology has been proven at SA 17, it has been retained as a component of the final remedy. The selected remedy for SA 17 groundwater consists of the following actions to address the RAOs:

- Institutional controls consisting of deed restrictions to prohibit the use of groundwater and restrict building over the plume area.

- Active remediation of the source area by periodic injection of a biostimulant along with pH buffering to promote ERD that will limit source area contributions of COCs to the dissolved plume.

- Long term groundwater monitoring to demonstrate effectiveness of the treatments in controlling the plume source and preventing off-site groundwater contamination.

- Long term groundwater monitoring to track stabilization and/or shrinkage of the dissolved plume (away from the source area) to demonstrate that the site is a candidate for monitored natural attenuation only

- Identification of and groundwater monitoring at a Temporary Point of Compliance located at the facility boundary.

- Submittal of a Natural Attenuation with Monitoring Plan to effect final site cleanup.

This remedy would protect human health and the environment. There is no current groundwater usage at the site and institutional controls would protect against future groundwater usage and exposure. Current and future construction activity will also be restricted at the site until the remedial objectives are met. As required by the Finding of Suitability for Early Transfer (FOSET), components of this selected remedy will be in place as deemed necessary until the Florida GCTLs are met. The above components are discussed in more detail in the following sections.

4.1 LAND USE CONTROLS

The SA 17 parcel has been transferred to the City via "Early Transfer." As part of this process, land use controls (LUCs) were instituted to the limits of the original site SA 17 boundary (as depicted on Figure 3) to protect human health and the environment. These LUCs prohibit the use of groundwater until contaminant concentrations are reduced to meet the Florida GCTLs. LUCs also restrict the future site use to industrial, commercial, and recreational activities. Residential uses (including housing, daycares, and schools) and agricultural uses are prohibited. The land and groundwater use controls were incorporated into the transfer deed dated April 18, 2008 and include the following (State of Florida, Orange County, 2008).

Wells and Groundwater: Installation of any wells for extraction or use of groundwater for any purpose other than for groundwater investigation is prohibited without prior consent from the Navy and FDEP.

These groundwater restrictions will minimize the potential for human exposure to contaminated groundwater through the following pathways:

- Direct skin contact with contaminated groundwater

- Ingestion (drinking) of contaminated groundwater
- Inhalation of vapors from contaminated groundwater

Commercial and Industrial: Commercial or industrial uses of the property which would cause direct exposure to contaminated soil by workers in excess of the worker exposure criteria are prohibited (exposure criteria are set forth in Table VI, Chapter 62-777, Florida Administrative Code (April 2005), as may be amended in future). Uses incidental to an otherwise commercial or industrial use which would cause exposures to anyone greater than those for the worker are also prohibited. Surface improvements or alterations to the property that reduce or eliminate exposure to contaminated soil may be used to overcome these exceptions upon demonstration to the Navy and FDEP that those improvements or alterations have reduced risks to acceptable levels.

Agricultural: Agricultural uses are prohibited without prior written approval from the Navy and FDEP.

Residential: Residential or residential-like uses (such as housing, child care facilities, any kind of school, playgrounds, adult convalescent, or nursing care facilities) are prohibited without prior written approval from the Navy and FDEP.

Excavation Control: Excavation, drilling, other disturbance, or removal of soil from the property is prohibited without prior written consent from the Navy and FDEP.

Construction Control: The use of existing buildings and the construction of any new buildings are prohibited on the property without prior written consent from the Navy and FDEP. This control was established because vapor barriers or other measures to mitigate vapor intrusion may be required to prevent exposure to VOCs migrating from contaminated groundwater until cleanup goals are achieved.

Remedial Systems Non-Interference Controls: Tampering with or damaging groundwater monitoring and/or remediation systems is prohibited, but adjustments may be made to the system upon agreement between the Navy and the current property owner. FDEP approval of any adjustments that affect the function of these systems is also required. Any future remedial or monitoring systems will be coordinated with the homeowner to minimize interference with the use of their property.

The Navy's deed of conveyance for SA 17 includes appropriate access rights so that the Navy may undertake future groundwater monitoring, compliance inspections, and any other investigative or remedial measures necessary for the long-term protection of human health and the environment. The deed provides similar access rights to FDEP and requires Navy and FDEP approval prior to removal or modification of the groundwater restrictions imposed on the property.

Deed transfer of SA 17 to the City or another owner does not affect the investigation, remediation, operation and maintenance, or long-term monitoring requirements set by the OPT for SA 17 or the Navy's responsibility to fully comply with all applicable federal and state legal requirements. The Navy currently anticipates continuation of semi-annual groundwater monitoring, which began in September 2007 and has been completed through 2011. Monitoring requirements for 2012 and beyondwill be determined based on the data that have been collected in accordance with the Sampling and Analysis Plan for Long Term Monitoring at Study Area 17 (Tetra Tech, 2010).

At the OPT Meeting in January 2009, the City agreed to impose the same groundwater restrictions for the adjacent property as those in place at SA 17. This was done in order to protect human health with regard to potential migration of the deeper portion of the plume to east of the site.

4.2 ACTIVE REMEDIATION

Additional source area treatment using a biostimulant for enhanced biodegradation is an integral component of the final remedy. Sample results from post-EOS® injection events monitoring (2006-2008) showed significant TCE concentration reductions at various source area wells; however, concentration rebounds were observed at some locations, particularly in Zone C wells. The rebound in COC levels were confined to the source area wells as TCE is not a component of the downgradient plume. Consumption of and/or an inadequate EOS® supply and low groundwater pH are considered the primary contributing factors for the concentration rebounds. In addition, biological samples did not show the expected increase in microbial populations favorable for breakdown and destruction of TCE and it daughter products. At SA 17, future injections will include both a carbon source (e.g., EOS®) and an amendment to create a favorable pH range in the aquifer. Site sampling and analysis that was conducted in 2011 included testing and analysis to determine if inoculation of the aquifer with a microbial consortium (i.e., bioaugmentation) is a necessary component of future treatments to better assure that ERD can successfully address both TCE and daughter products (Solutions, 2011).

In general, slow releasing substrates such as vegetable oil suspensions with less than 10 percent oil will last for 2-3 years and the source zone will require re-injections to continue the ERD process (ITRC 2008). Typically, monitoring of various parameters such as TOC of the groundwater and contaminant concentrations over a period of time will provide discrete data to indicate that additional biostimulant injections are needed to continue the ERD processes. Empirical data from previous EOS® injections at SA 17 have shown that concentration rebounds occurred approximately in the 2-3 year timeframe after the EOS® injections in the source area. Ongoing monitoring data for SA 17 will be evaluated for ERD performance and potential indicators (such as pH, TOC, inhibitors) that the biological processes have stalled.

Decisions on if/when future biostimulant/bioaugmentation injections are needed will be made after reviewing the TOC, pH, ORP, contaminant concentration, and other relevant data. Additional source area injections are projected to be needed at a time interval of approximately two years to reduce concentrations of COCs that might otherwise contribute to the dissolved plume. Actual timing of the injections will be based on the semiannual groundwater monitoring results and trend analysis for the source area and in-plume wells.

Based on historical data, an increase in the downgradient migration of TCE is not expected if source area injections are properly timed. Historically, TCE has not been a component of the dissolved plume beyond approximately 250 feet downgradient of the source area. However, migration of TCE degradation products (cis-DCE and VC) to downgradient areas of the plume appears to be occurring. Monitoring will be conducted to determine if physical, geochemical, and/or biological conditions necessary to affect natural attenuation of the dissolved plume are present, or if the down gradient advective flow of biostimulants from the source area treatments can affect enhanced biostimulation to control the dissolved plume. If off-site migration of COCs in the dissolved plume greater than GCTLs at the POC wells cannot be prevented, then the OPT will determine a course of action that may include extending active remediation (e.g. biostimulation, bioaugmentation) to downgradient areas of the dissolved plume.

The ultimate goal of source area treatment is to achieve concentrations of COCs in the source area that are consistent with the FDEP Natural Attenuation Default Criteria (NADC); achievement of this goal would signal an end to active remediation (i.e., termination of biostimulation/bioaugmentation) and a reliance on MNA for final site cleanup. Therefore, future source area treatments will be conducted periodically until concentration trends, geochemical conditions (including pH and ORP), and microbial populations indicate that NADC criteria can be achieved without additional injections.

4.3 LONG TERM MONITORING/MONITORED NATURAL ATTENUATION

Semiannual groundwater monitoring at SA 17 will be performed to verify the progress of remediation. The LTM will include collection of groundwater samples for VOC analysis at selected wells and water level measurements in most site wells (currently 66 wells). Table 3 provides a list of the identified COCs and the applicable GCTLs and NADC criteria. Table 4 provides a list of the wells proposed for monitoring groundwater conditions at the site along with the initial analytical program. Monitoring wells used in the monitoring program include wells representing the four aquifer zones identified during the investigation of SA 17. As noted in Table 4, source area wells, in plume, and downgradient locations will be included for each aquifer zone. It is noted that additional wells may be installed, if required, to delineate any future downgradient extension of the plume in Zone C and to provide POC locations for groundwater; the exact locations of these wells is to be determined. Also, due to the close proximity of multiple wells within the source area of Zones B and C, only select representative wells have been identified for sampling to reduce redundancy of the sampling and analyses effort.

Additional injection events of biostimulants in the source area are planned until concentrations of all COCs approach or attain levels consistent with FDEP NADC levels. At this point, the LTM program will be re-evaluated and adjusted to focus on MNA of the entire dissolved plume until GTCLs are reached. MNA parameters such as DO, ferrous iron, sulfate/sulfide, methane, etc., will be analyzed during the MNA period.

In the event that multiple MNA monitoring events demonstrate that natural attenuation processes are not sufficient to stabilize the plume and prevent continued plume migration, then MNA may be suspended and additional active remediation measures (see Section 4.2) will be evaluated to ensure protection of human health and the environment.

4.4 SITE CLOSURE

As indicated above, it is the goal of the remedial effort to effect degradation of the source area using active remediation technologies (enhanced bioremediation) and monitored natural attenuation of the dissolved plume over time to meet the RAOs and to achieve site closure by effecting aquifer cleanup to GCTLs. During this period, LTM will be used to determine that the plume is stable and/or shrinking and that additional migration of the plume and/or conditions that may lead to unacceptable risk the human health or the environment does not occur. However, future LTM may demonstrate that asymptotic levels of contaminants in groundwater above the GCTLs may occur when the plume becomes stable within the site and LUC boundaries. If this condition is observed, then risk management options as described in F.A.C. Chapter 62-770.680 may provide an alternative means for effecting site closure by an FDEP determination of No Further Action with institutional controls.

Table 3
List of Chemicals of Concern for Groundwater
Study Area 17

COC	CAS Number	GCTL[a] (µg/L)	NADC[b] (µg/L)
1,1-Dichloroethene	75-35-4	7	70
cis-1,2-Dichloroethene	156-59-2	70	700
Tetrachloroethene	127-18-4	3	300
Trichloroethene	79-01-6	3	300
Vinyl Chloride	75-01-4	1	100

[a] FDEP GCTL – Groundwater Cleanup Target Levels F.A.C. 62-777 Table 1
[b] FDEP GCTL – Natural Attenuation Default Criteria F.A.C. 62-777 Table 5, February 2005.

Table 4
LTM Sampling Program
Study Area 17

Well Number	Screened Interval (feet bgs)	Rationale and Comments	Sample Collection[a]
OLD-17-01A	2 to 12	Water level only.	ns
OLD-17-02A	2 to 12	Water level only.	ns
OLD-17-03A	2 to 12	Water level only.	ns
OLD-17-04A	2 to 12	Downgradient, to monitor plume migration.	Yes
OLD-17-06A	2 to 11	Water level only.	ns
OLD-17-10C	42 to 47	Downgradient, to monitor natural attenuation parameters upgradient of plume, and document upgradient target analyte concentrations.	Yes
OLD-17-13B	15 to 20	Downgradient, to monitor plume migration.	Yes
OLD-17-14C	43 to 48	Water level only.	ns
OLD-17-15A	2 to 12	Water level only.	ns
OLD-17-16B	15 to 20	Side gradient, to monitor plume stability.	Yes
OLD-17-17C	43 to 48	Water level only.	ns
OLD-17-18A	2 to 12	Water level only.	ns
OLD-17-19B	25 to 30	Side gradient, to monitor plume stability and natural attenuation.	Yes
OLD-17-20C	47 to 52	Downgradient, to monitor plume migration and natural attenuation.	Yes

Well Number	Screened Interval (feet bgs)	Rationale and Comments	Sample Collection[a]
OLD-17-21B	15 to 20	Water level only.	ns
OLD-17-22C	43 to 48	Water level only.	ns
OLD-17-23AR	1.5 to 11.5	Source area, to monitor plume concentration trends.	Yes
OLD-17-24BR	15 to 20	Source area, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-25CR	58 to 63	Vertically Downgradient of source area, to monitor plume migration.	Yes
OLD-17-26A	2 to 12	Downgradient, to monitor plume migration.	Yes
OLD-17-27B	15 to 20	In plume, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-28C	58 to 63	In plume, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-31A	5 to 6	Missing/damaged downgradient well point – will be replaced. To determine potential contaminant discharge to ditch.	Yes
OLD-17-32A	5 to 6	Missing/damaged downgradient well point – will be replaced. To determine potential contaminant discharge to ditch.	Yes
OLD-17-33A	5 to 6	Missing/damaged downgradient well point – will be replaced. To determine potential contaminant discharge to ditch.	Yes
OLD-17-34A	5 to 15	Water level only.	ns
OLD-17-35B	15 to 20	Water level only.	ns
OLD-17-36B	24 to 29	Water level only.	ns
OLD-17-37C	45 to 50	Water level only.	ns
OLD-17-38D	65 to 70	Downgradient, to monitor plume migration and natural attenuation.	Yes
OLD-17-39C	45 to 50	Water level only.	ns
OLD-17-40C	45 to 50	Side gradient, to monitor plume stability and natural attenuation outside plume.	Yes
OLD-17-41C	46 to 51	Side gradient, to monitor plume stability.	Yes
OLD-17-42B	24 to 29	Water level only.	ns
OLD-17-43C	46 to 51	Downgradient, to monitor plume migration and natural attenuation.	Yes
OLD-17-44A	5 to 15	Water level only.	ns
OLD-17-45C	45 to 50	Downgradient, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-46C	45 to 50	Downgradient, to monitor plume migration.	Yes
OLD-17-47D	52 to 57	Downgradient, to monitor plume migration.	Yes
OLD-17-48C	45 to 50	Downgradient, to monitor plume migration and natural attenuation.	Yes
OLD-17-49D	52 to 57	Downgradient, to monitor plume migration and natural attenuation.	Yes
OLD-17-50C	45 to 50	Plume edge, side gradient, to monitor plume stability.	Yes
OLD-17-51D	52 to 57	Plume edge, side gradient, to monitor plume stability.	Yes

Well Number	Screened Interval (feet bgs)	Rationale and Comments	Sample Collection[a]
OLD-17-53C1	30 to 34.5	Source area, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-54B	20 to 25	Source area, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-55C	35 to 40	Source area, to monitor plume concentration trends and natural attenuation.	Yes
OLD-17-56B	20 to 25	Source area, to monitor plume concentration trends and natural attenuation.	Yes

[a] Sample collection and water level measurements to be conducted semiannually.
All samples analyzed for VOCs (1,1-Dichloroethene, cis-1,2-Dichloroethene, Tetrachloroethene, Trichloroethene, and Vinyl Chloride) and MNA parameters [dissolved gases (methane, ethane, and ethane), anions (sulfate), and total organic carbon (TOC)].
ns – no sample collected.

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5.0 COMMUNITY ACCEPTANCE

Community acceptance of the remedial strategy for SA 17 was evaluated during meetings of the facility's Restoration Advisory Board (RAB). While the final remedy for SA 17 had not been presented in a decision document prior to adjournment of the RAB in September 2007, the remedial strategy for SA 17 had been determined and presented, and the RAB provided no comments on the remedy at that time. RAB meetings were open to the public and their biannual meetings publicized in *The Orlando Sentinel.* The public was given an opportunity to comment during the presentations that discussed remedial options and gave status updates for NTC sites, and during annual reviews of the BRAC Business Plan. Comments and questions from the RAB and the general public about the SA 17 remedy were addressed at the RAB meetings.

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6.0 DECLARATION

Based on the Administrative Record compiled for this corrective action, the Navy has determined that the remedy selected for SA 17 is appropriate and protective of human health and the environment and complies with Federal and State regulatory requirements. The OPT concurs with the selected remedy.

STUDY AREA 17	
David P. Grabka	4/18/12
Florida Department of Environmental Protection	Date
Mark L. Davidson	4/18/12
U.S. Department of the Navy	Date

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FIGURES

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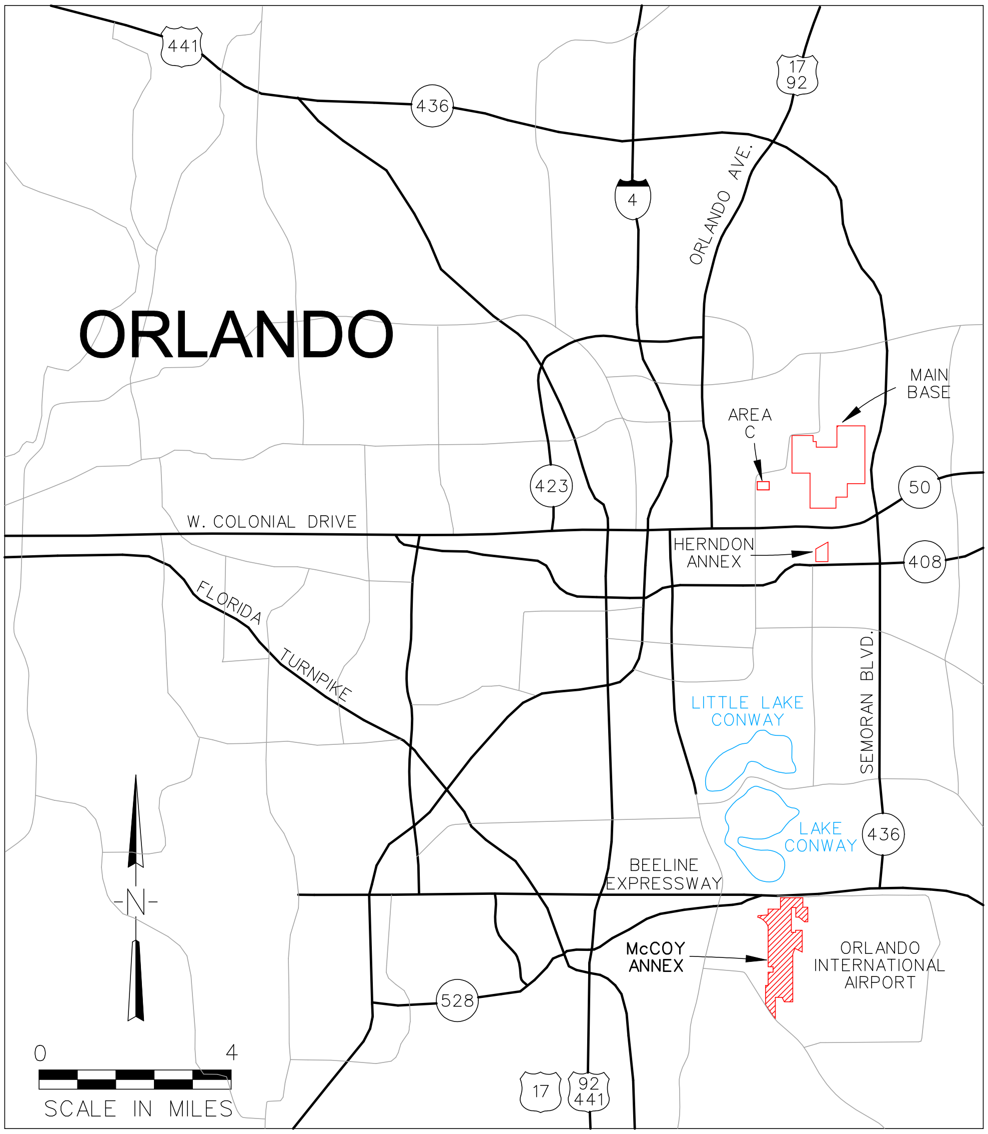
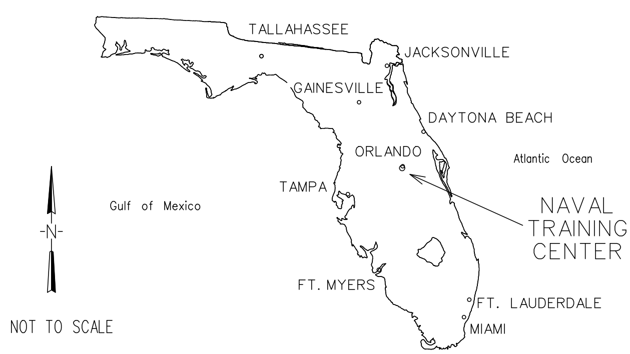
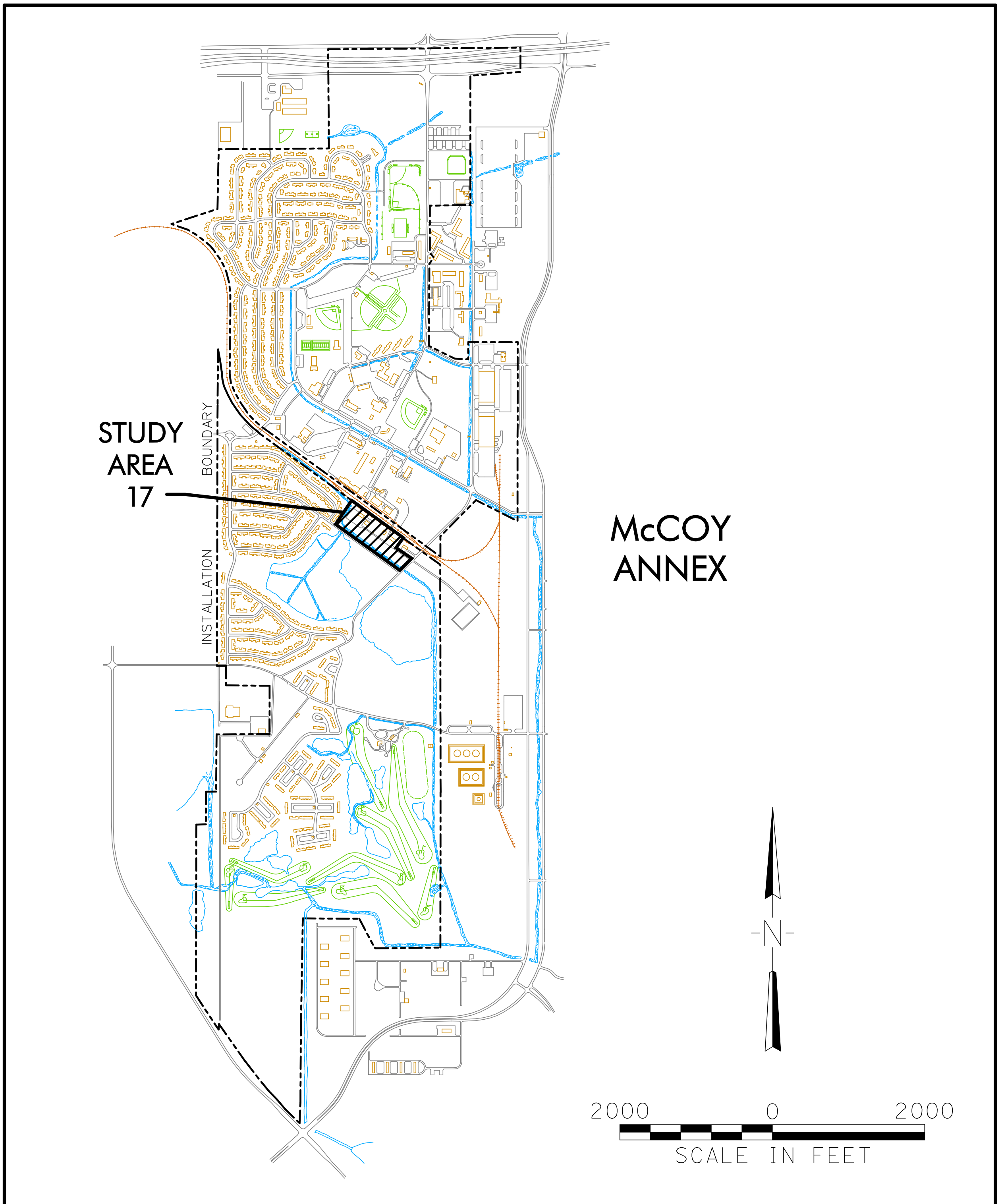




DRAWN BY **WRW** DATE **6/11/2010**		**McCOY ANNEX LOCATION**	CONTRACT NO. **N62467-04-D-0055**
CHECKED BY **TKG** DATE **6/11/2010**			OWNER NO. **--------**
REVISED BY **JAW** DATE **11/30/2011**		**NAVAL TRAINING CENTER ORLANDO, FLORIDA**	APPROVED BY **---** DATE **--------**
SCALE **AS NOTED**			DRAWING NO. **FIGURE 1** REV. **0**

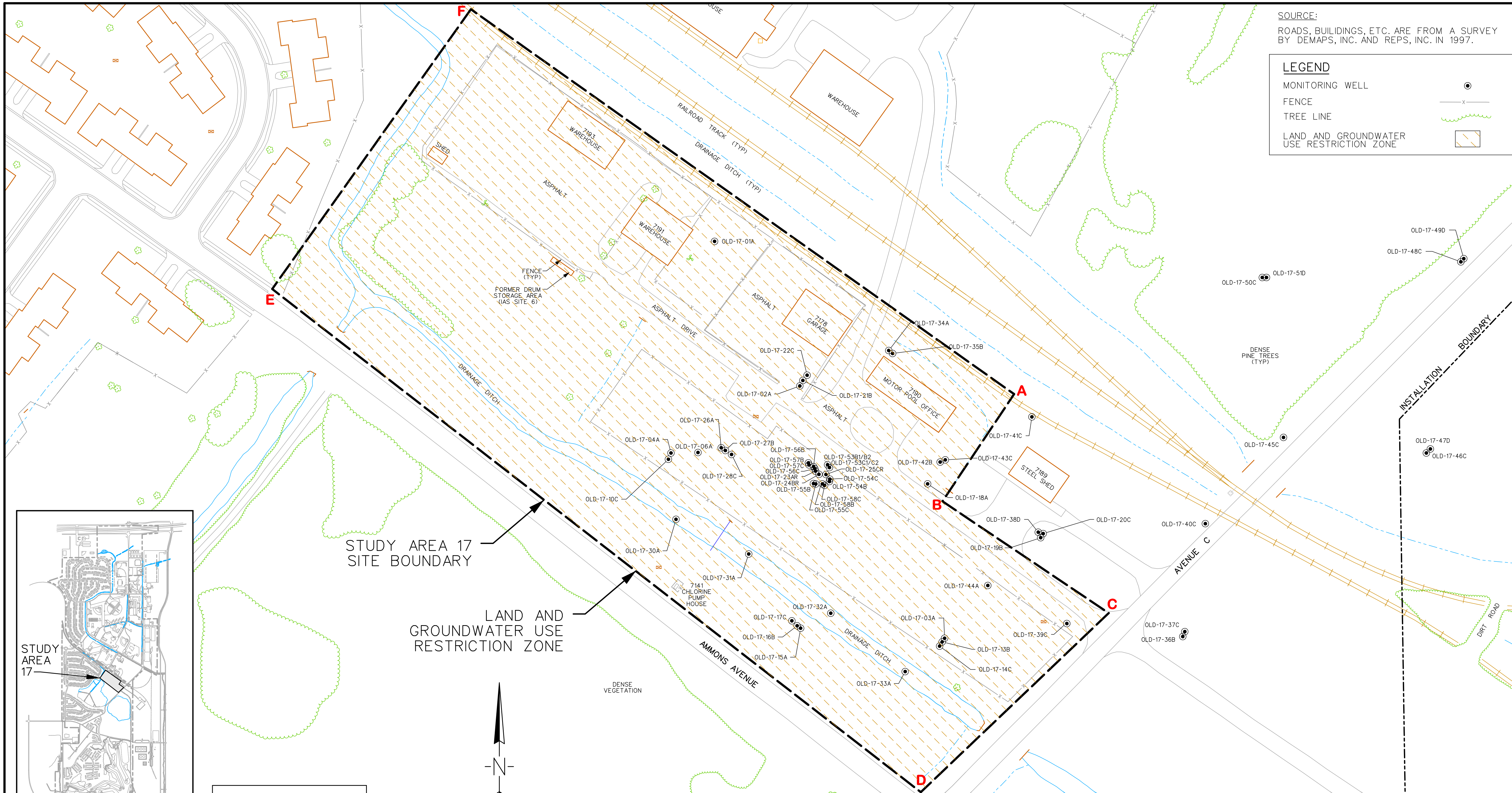
NBRC-AV.dgn 5-14-08

CAD FILE NO./DATE: k:\dgn\navy\orlando\sites\sa17\sa17-139.dgn



DRAWN BY JAW	DATE 11/30/2011	LOCATION OF STUDY AREA 17 NAVAL TRAINING CENTER ORLANDO, FLORIDA	CONTRACT NO. N62467-04-D-0055	
CHECKED BY TKG	DATE 11/30/2011		OWNER NO.	
REVISED BY -	DATE -		APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2	REV. 0

NBRC-AV.dgn 5-14-08



LOCATION COORDINATES

LOC.	EASTING	NORTHING
A	547082	1490495
B	546997	1490368
C	547194	1490236
D	546971	1490024
E	546205	1490619
F	546440	1490950

DRAWN BY	DATE
WRW	9-1-2009
CHECKED BY	DATE
TJG	9-1-2009
REVISED BY	DATE
JAW	11/30/2011
SCALE	
AS NOTED	

SITE MAP
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CONTRACT NO.
N62467-04-D-0055

OWNER NO.

APPROVED BY — DATE
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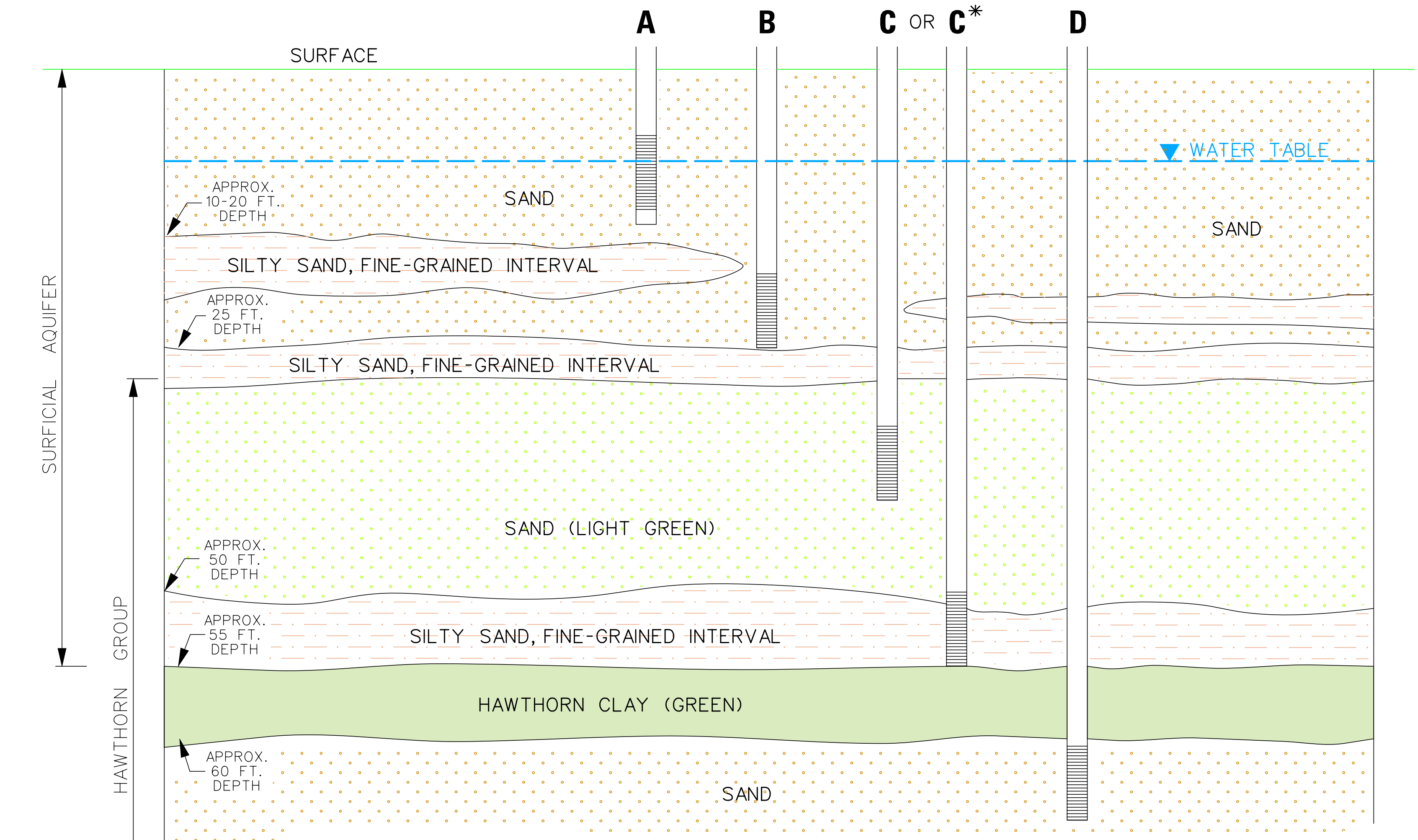
DRAWING NO. **FIGURE 3**
REV. 0

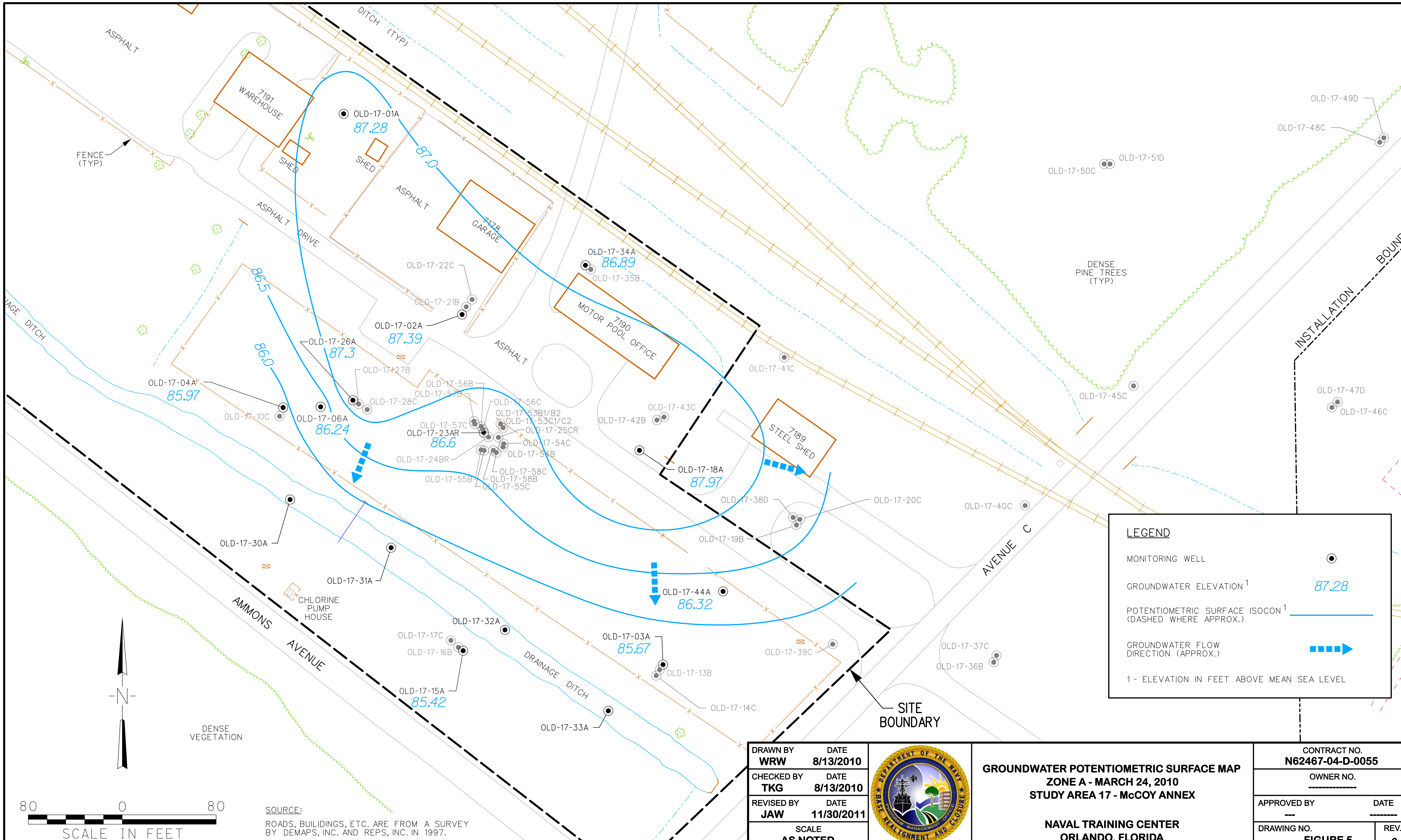


NOTES:

1) "C" AND "D" WELLS MAY OR MAY NOT BE DOUBLE CASED DEPENDING ON LOCATION.

* WELLS OLD-17-25C AND OLD-17-28C

DRAWN BY SRA	DATE 10-8-08		**WELL DEPTH SCHEMATIC STUDY AREA 17 - McCOY ANNEX**	CONTRACT NO. N62467-04-D-0055
CHECKED BY -	DATE -			OWNER NO. -
REVISED BY -	DATE -		**NAVAL TRAINING CENTER ORLANDO, FLORIDA**	APPROVED BY - DATE -
SCALE NOT TO SCALE				DRAWING NO. **FIGURE 4** REV. 0



SOURCE:
ROADS, BUILDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

DRAWN BY WRW	DATE 8/13/2010	GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A - MARCH 24, 2010 STUDY AREA 17 - McCOY ANNEX	CONTRACT NO. N62467-04-D-0055	
CHECKED BY TKG	DATE 8/13/2010		OWNER NO. -------------	
REVISED BY JAW	DATE 11/30/2011	NAVAL TRAINING CENTER ORLANDO, FLORIDA	APPROVED BY ---	DATE --------
SCALE AS NOTED			DRAWING NO. FIGURE 5	REV. 0

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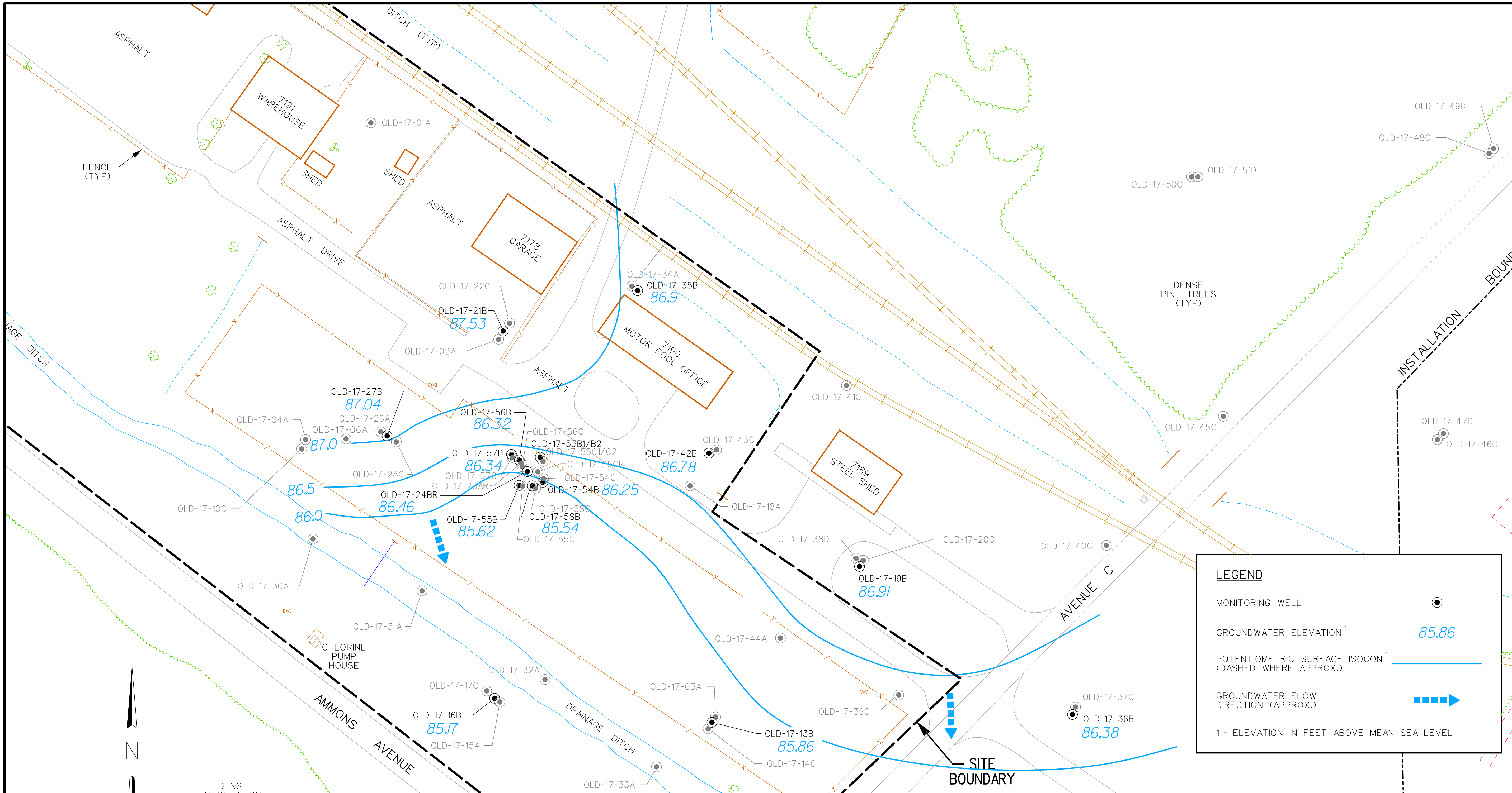

SOURCE:
ROADS, BUILDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

DRAWN BY WRW	DATE 8/13/2010	GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE B - MARCH 24, 2010 STUDY AREA 17 - McCOY ANNEX	CONTRACT NO. N62467-04-D-0055
CHECKED BY TKG	DATE 8/13/2010		OWNER NO. --------
REVISED BY JAW	DATE 11/30/2011	NAVAL TRAINING CENTER ORLANDO, FLORIDA	APPROVED BY --- / DATE --------
SCALE AS NOTED			DRAWING NO. FIGURE 6 / REV. 0

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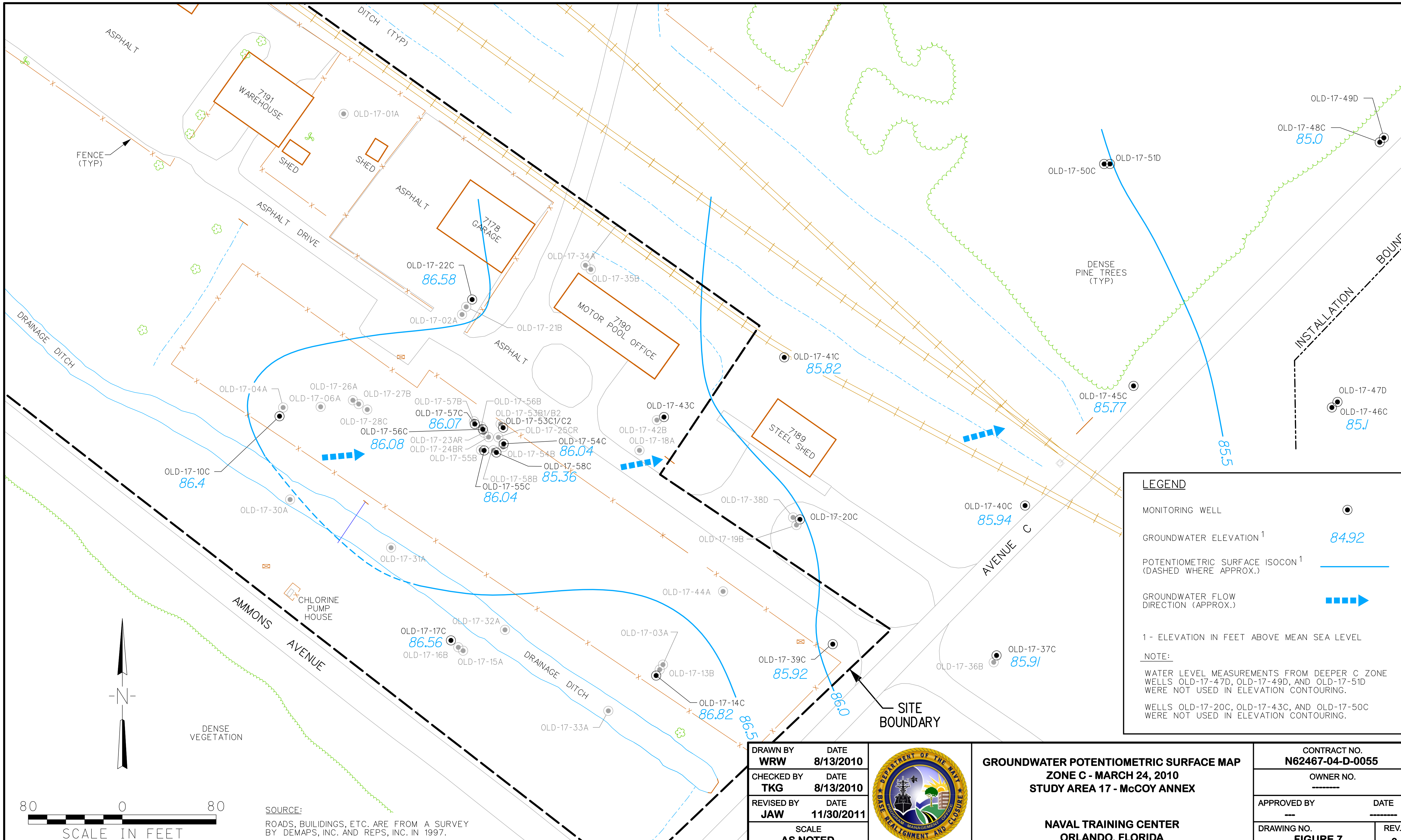

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WRW	8/13/2010
CHECKED BY	DATE
TKG	8/13/2010
REVISED BY	DATE
JAW	11/30/2011
SCALE	
AS NOTED	

GROUNDWATER POTENTIOMETRIC SURFACE MAP
ZONE C - MARCH 24, 2010
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CONTRACT NO.	
N62467-04-D-0055	
OWNER NO.	

APPROVED BY	DATE
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FIGURE 7	0

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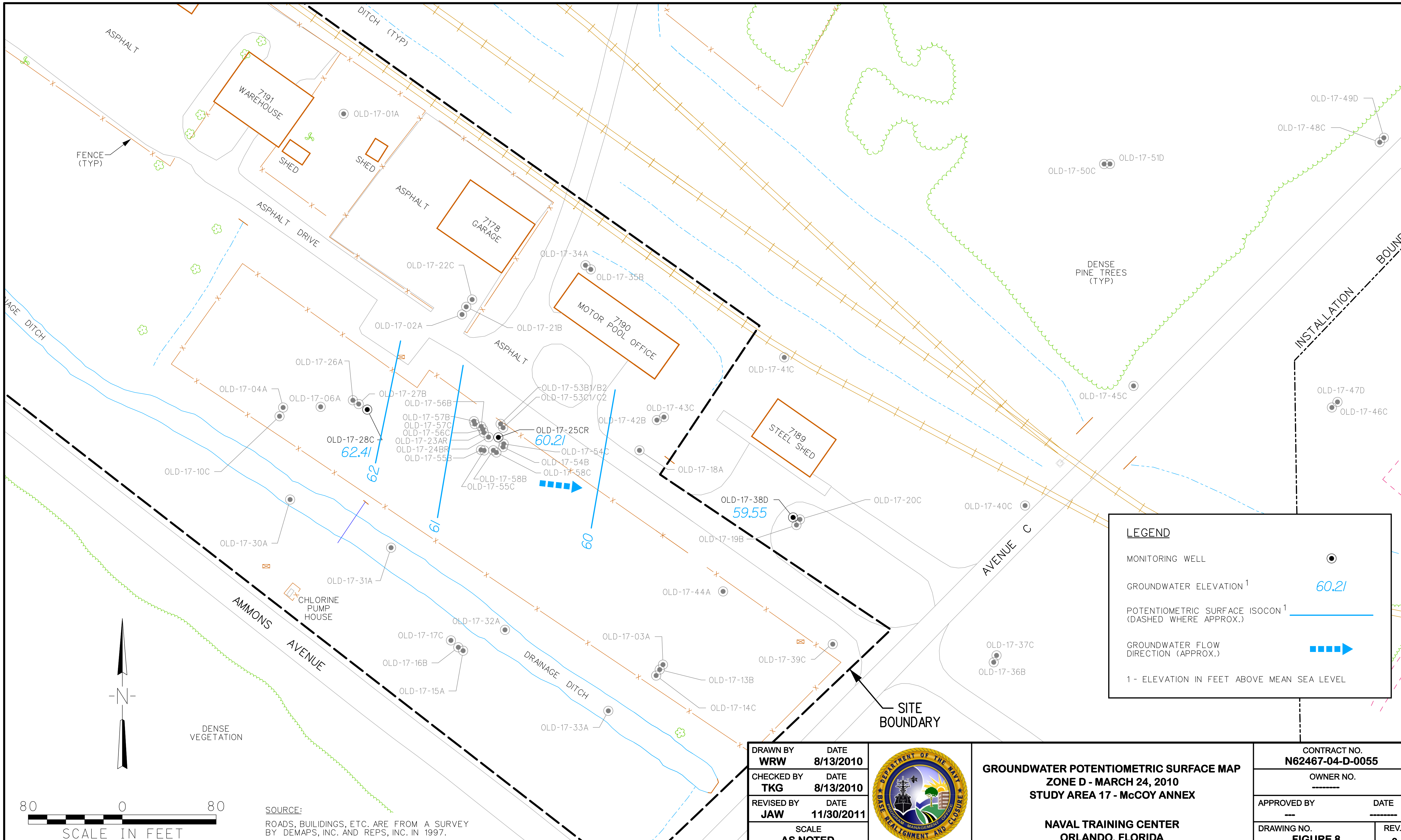

LEGEND

MONITORING WELL

GROUNDWATER ELEVATION [1] 60.21

POTENTIOMETRIC SURFACE ISOCON [1] (DASHED WHERE APPROX.)

GROUNDWATER FLOW DIRECTION (APPROX.)

1 - ELEVATION IN FEET ABOVE MEAN SEA LEVEL

SOURCE:
ROADS, BUILIDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

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WRW	8/13/2010
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TKG	8/13/2010
REVISED BY	DATE
JAW	11/30/2011
SCALE	
AS NOTED	

GROUNDWATER POTENTIOMETRIC SURFACE MAP
ZONE D - MARCH 24, 2010
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CONTRACT NO.	
N62467-04-D-0055	
OWNER NO.	

APPROVED BY	DATE
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FIGURE 8	0

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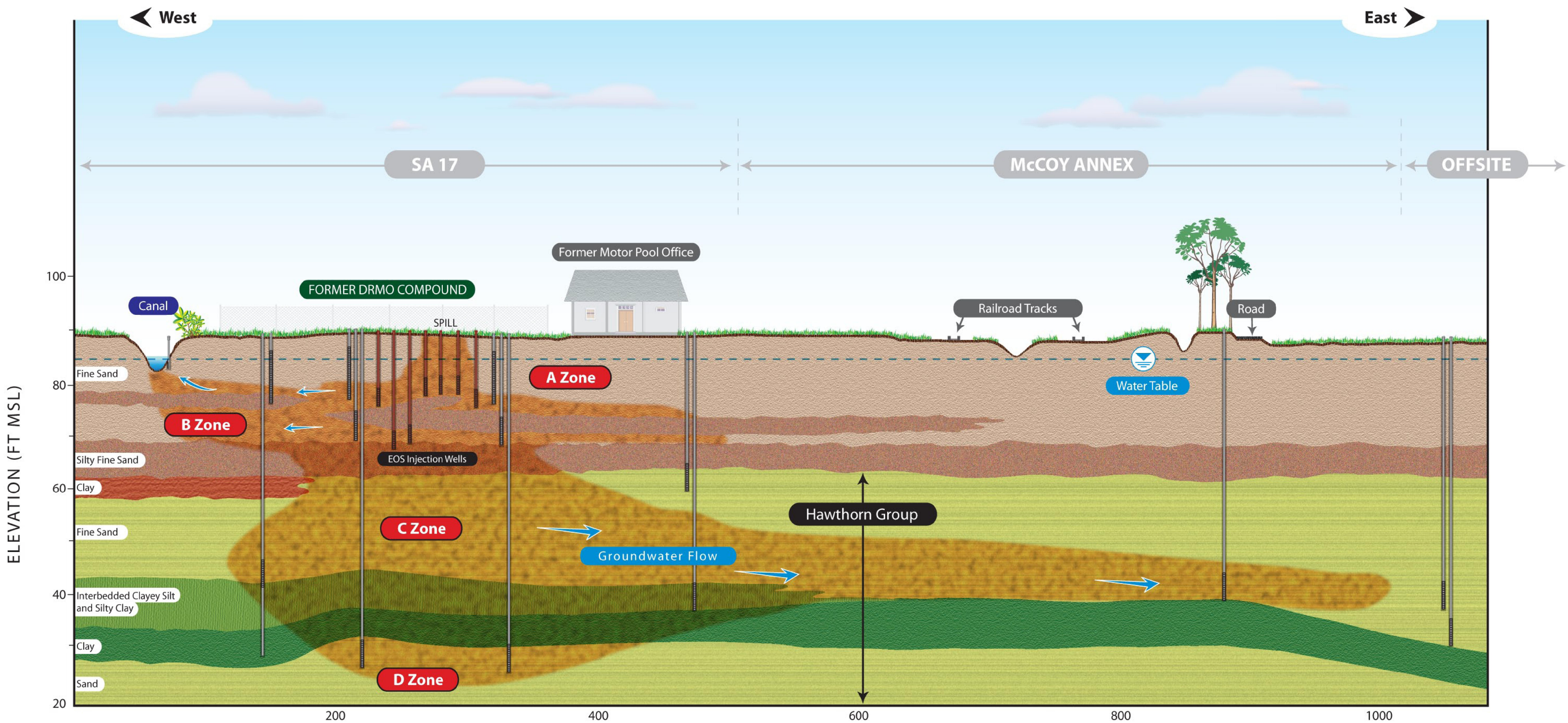


LEGEND

DIRECTION OF GROUNDWATER FLOW

DRAWN BY WRW	DATE 7/22/2010	CONCEPTUAL SITE MODEL STUDY AREA 17	CONTRACT NO. N62467-04-D-0055
CHECKED BY TKG	DATE 7/22/2010		OWNER NO. --------
REVISED BY JAW	DATE 11/30/2011	NAVAL TRAINING CENTER ORLANDO, FLORIDA	APPROVED BY --- DATE --------
SCALE AS NOTED			DRAWING NO. FIGURE 9 REV. 0

DEPARTMENT OF THE NAVY BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE

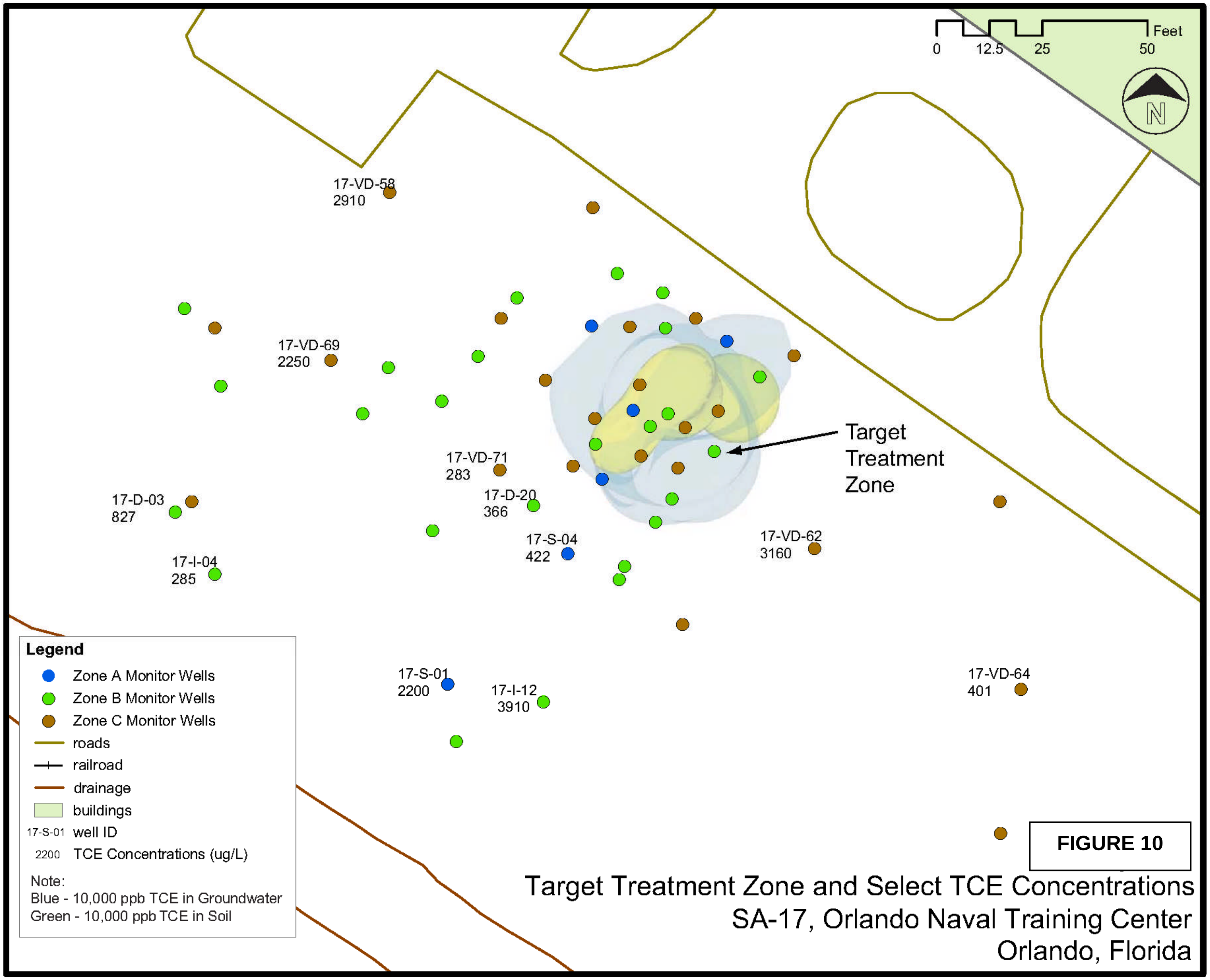


FIGURE 10

Target Treatment Zone and Select TCE Concentrations
SA-17, Orlando Naval Training Center
Orlando, Florida

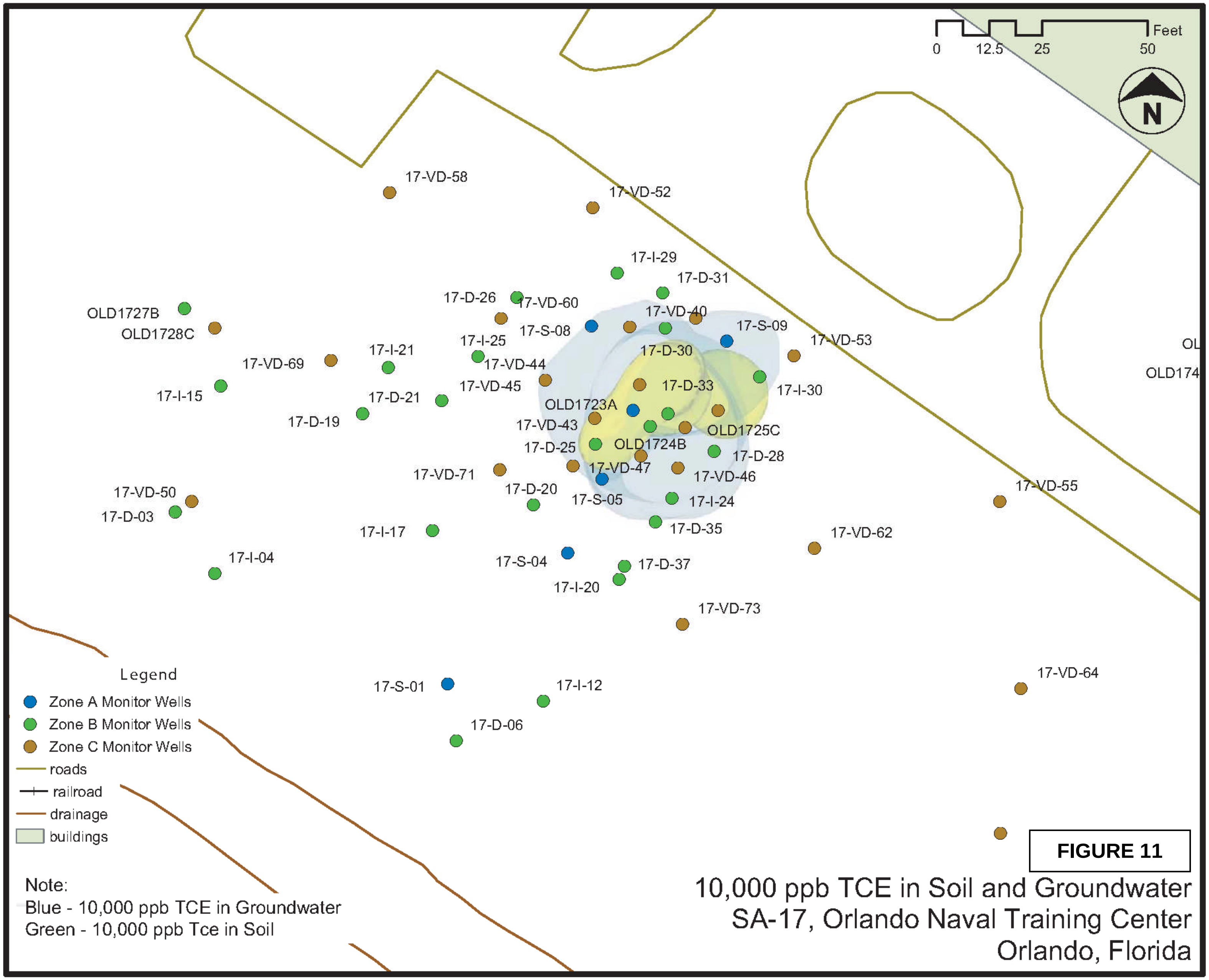
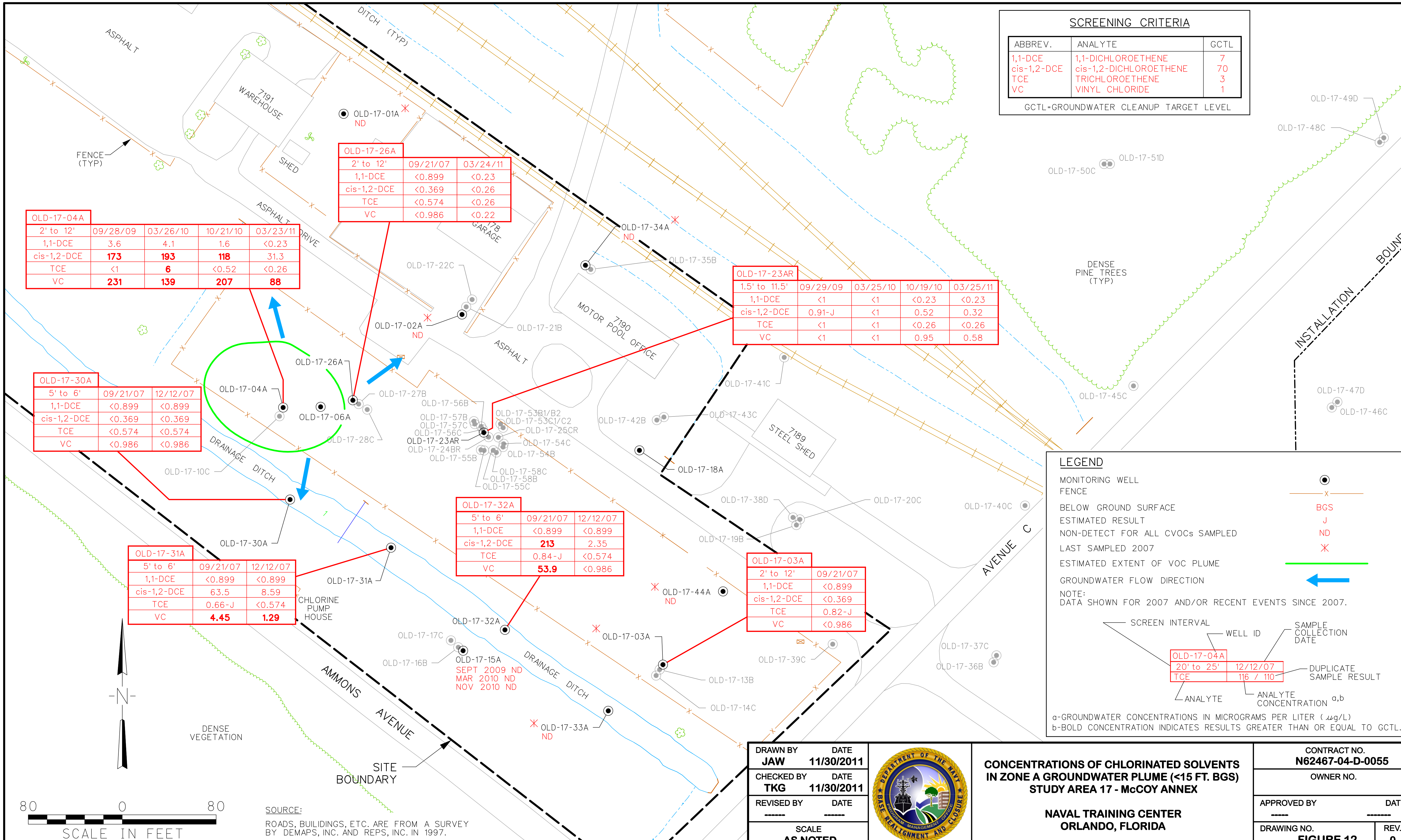


FIGURE 11

10,000 ppb TCE in Soil and Groundwater
SA-17, Orlando Naval Training Center
Orlando, Florida



SCREENING CRITERIA

ABBREV.	ANALYTE	GCTL
1,1-DCE	1,1-DICHLOROETHENE	7
cis-1,2-DCE	cis-1,2-DICHLOROETHENE	70
TCE	TRICHLOROETHENE	3
VC	VINYL CHLORIDE	1

GCTL=GROUNDWATER CLEANUP TARGET LEVEL

OLD-17-04A

2' to 12'	09/28/09	03/26/10	10/21/10	03/23/11
1,1-DCE	3.6	4.1	1.6	<0.23
cis-1,2-DCE	**173**	**193**	**118**	31.3
TCE	<1	**6**	<0.52	<0.26
VC	**231**	**139**	**207**	**88**

OLD-17-26A

2' to 12'	09/21/07	03/24/11
1,1-DCE	<0.899	<0.23
cis-1,2-DCE	<0.369	<0.26
TCE	<0.574	<0.26
VC	<0.986	<0.22

OLD-17-23AR

1.5' to 11.5'	09/29/09	03/25/10	10/19/10	03/25/11
1,1-DCE	<1	<1	<0.23	<0.23
cis-1,2-DCE	0.91-J	<1	0.52	0.32
TCE	<1	<1	<0.26	<0.26
VC	<1	<1	0.95	0.58

OLD-17-30A

5' to 6'	09/21/07	12/12/07
1,1-DCE	<0.899	<0.899
cis-1,2-DCE	<0.369	<0.369
TCE	<0.574	<0.574
VC	<0.986	<0.986

OLD-17-32A

5' to 6'	09/21/07	12/12/07
1,1-DCE	<0.899	<0.899
cis-1,2-DCE	**213**	2.35
TCE	0.84-J	<0.574
VC	**53.9**	<0.986

OLD-17-31A

5' to 6'	09/21/07	12/12/07
1,1-DCE	<0.899	<0.899
cis-1,2-DCE	63.5	8.59
TCE	0.66-J	<0.574
VC	**4.45**	**1.29**

OLD-17-03A

2' to 12'	09/21/07
1,1-DCE	<0.899
cis-1,2-DCE	<0.369
TCE	0.82-J
VC	<0.986

LEGEND

MONITORING WELL
FENCE
BELOW GROUND SURFACE — BGS
ESTIMATED RESULT — J
NON-DETECT FOR ALL CVOCs SAMPLED — ND
LAST SAMPLED 2007
ESTIMATED EXTENT OF VOC PLUME
GROUNDWATER FLOW DIRECTION

NOTE:
DATA SHOWN FOR 2007 AND/OR RECENT EVENTS SINCE 2007.

SCREEN INTERVAL — WELL ID — SAMPLE COLLECTION DATE

OLD-17-04A	
20' to 25'	12/12/07
TCE	116 / 110

ANALYTE — ANALYTE CONCENTRATION a,b — DUPLICATE SAMPLE RESULT

a-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER ($\mu g/L$)
b-BOLD CONCENTRATION INDICATES RESULTS GREATER THAN OR EQUAL TO GCTL.

SOURCE:
ROADS, BUILDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

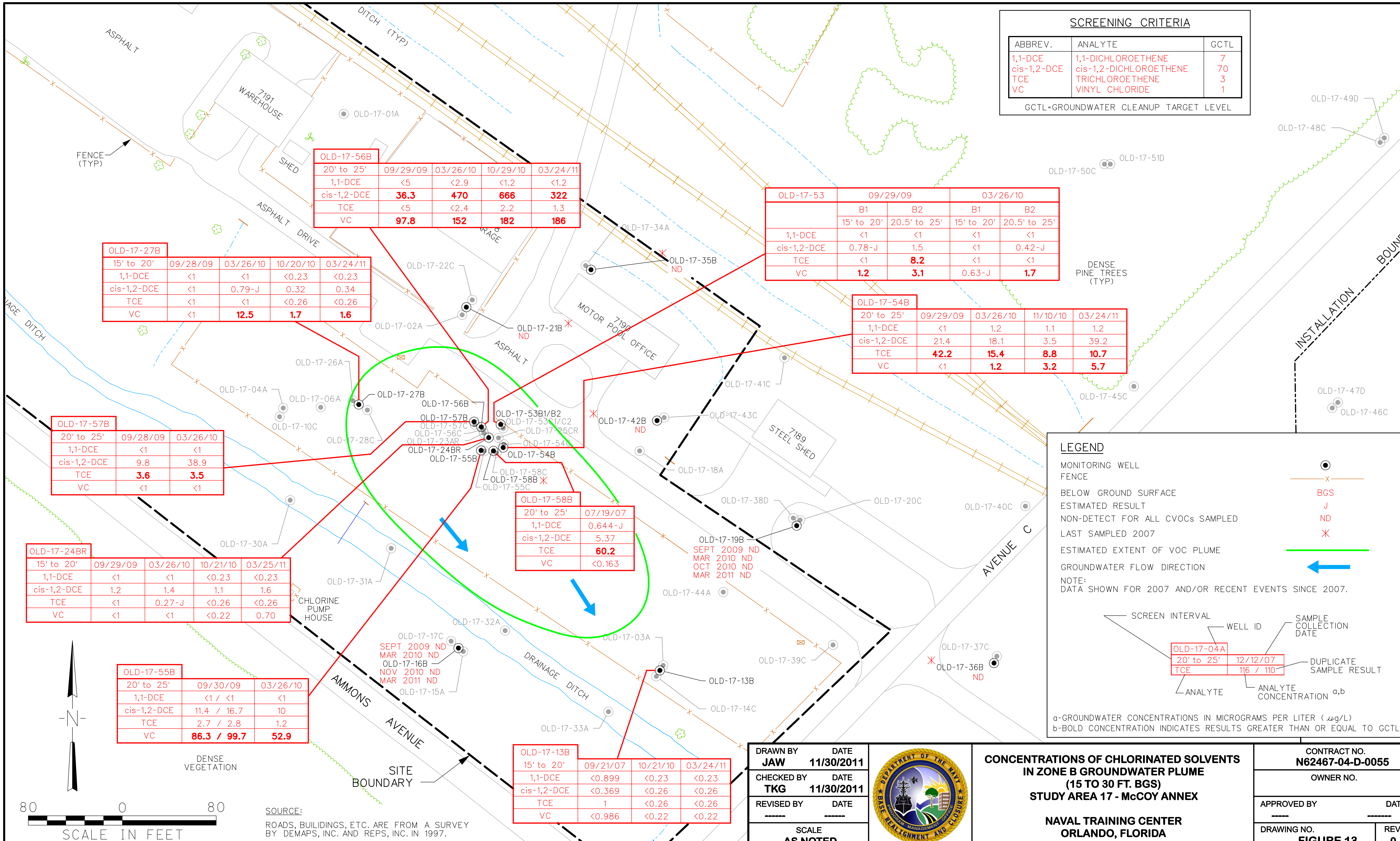
DRAWN BY	DATE
JAW	11/30/2011
CHECKED BY	DATE
TKG	11/30/2011
REVISED BY	DATE
------	------
SCALE	
AS NOTED	

CONCENTRATIONS OF CHLORINATED SOLVENTS IN ZONE A GROUNDWATER PLUME (<15 FT. BGS) STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER ORLANDO, FLORIDA

CONTRACT NO. **N62467-04-D-0055**
OWNER NO.
APPROVED BY ----- DATE -------
DRAWING NO. **FIGURE 12** REV. **0**

FORM CADD NO. SDIV-BH.DGN - REV 2 - 10/23/03



SCREENING CRITERIA

ABBREV.	ANALYTE	GCTL
1,1-DCE	1,1-DICHLOROETHENE	7
cis-1,2-DCE	cis-1,2-DICHLOROETHENE	70
TCE	TRICHLOROETHENE	3
VC	VINYL CHLORIDE	1

GCTL=GROUNDWATER CLEANUP TARGET LEVEL

OLD-17-56B 20' to 25'	09/29/09	03/26/10	10/29/10	03/24/11
1,1-DCE	<5	<2.9	<1.2	<1.2
cis-1,2-DCE	**36.3**	**470**	**666**	**322**
TCE	<5	<2.4	2.2	1.3
VC	**97.8**	**152**	**182**	**186**

OLD-17-27B 15' to 20'	09/28/09	03/26/10	10/20/10	03/24/11
1,1-DCE	<1	<1	<0.23	<0.23
cis-1,2-DCE	<1	0.79-J	0.32	0.34
TCE	<1	<1	<0.26	<0.26
VC	<1	**12.5**	**1.7**	**1.6**

OLD-17-53	09/29/09		03/26/10	
	B1	B2	B1	B2
	15' to 20'	20.5' to 25'	15' to 20'	20.5' to 25'
1,1-DCE	<1	<1	<1	<1
cis-1,2-DCE	0.78-J	1.5	<1	0.42-J
TCE	<1	**8.2**	<1	<1
VC	**1.2**	**3.1**	0.63-J	**1.7**

OLD-17-54B 20' to 25'	09/29/09	03/26/10	11/10/10	03/24/11
1,1-DCE	<1	1.2	1.1	1.2
cis-1,2-DCE	21.4	18.1	3.5	39.2
TCE	**42.2**	**15.4**	**8.8**	**10.7**
VC	<1	**1.2**	**3.2**	**5.7**

OLD-17-57B 20' to 25'	09/28/09	03/26/10
1,1-DCE	<1	<1
cis-1,2-DCE	9.8	38.9
TCE	**3.6**	**3.5**
VC	<1	<1

OLD-17-58B 20' to 25'	07/19/07
1,1-DCE	0.644-J
cis-1,2-DCE	5.37
TCE	**60.2**
VC	<0.163

OLD-17-24BR 15' to 20'	09/29/09	03/26/10	10/21/10	03/25/11
1,1-DCE	<1	<1	<0.23	<0.23
cis-1,2-DCE	1.2	1.4	1.1	1.6
TCE	<1	0.27-J	<0.26	<0.26
VC	<1	<1	<0.22	0.70

OLD-17-55B 20' to 25'	09/30/09	03/26/10
1,1-DCE	<1 / <1	<1
cis-1,2-DCE	11.4 / 16.7	10
TCE	2.7 / 2.8	1.2
VC	**86.3 / 99.7**	**52.9**

OLD-17-13B 15' to 20'	09/21/07	10/21/10	03/24/11
1,1-DCE	<0.899	<0.23	<0.23
cis-1,2-DCE	<0.369	<0.26	<0.26
TCE	1	<0.26	<0.26
VC	<0.986	<0.22	<0.22

LEGEND

MONITORING WELL	
FENCE	
BELOW GROUND SURFACE	BGS
ESTIMATED RESULT	J
NON-DETECT FOR ALL CVOCs SAMPLED	ND
LAST SAMPLED 2007	
ESTIMATED EXTENT OF VOC PLUME	
GROUNDWATER FLOW DIRECTION	

NOTE:
DATA SHOWN FOR 2007 AND/OR RECENT EVENTS SINCE 2007.

SCREEN INTERVAL — WELL ID — SAMPLE COLLECTION DATE

OLD-17-04A	
20' to 25'	12/12/07
TCE	116 / 110

DUPLICATE SAMPLE RESULT
ANALYTE
ANALYTE CONCENTRATION a,b

a-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER ($\mu g/L$)
b-BOLD CONCENTRATION INDICATES RESULTS GREATER THAN OR EQUAL TO GCTL.

SOURCE:
ROADS, BUILIDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

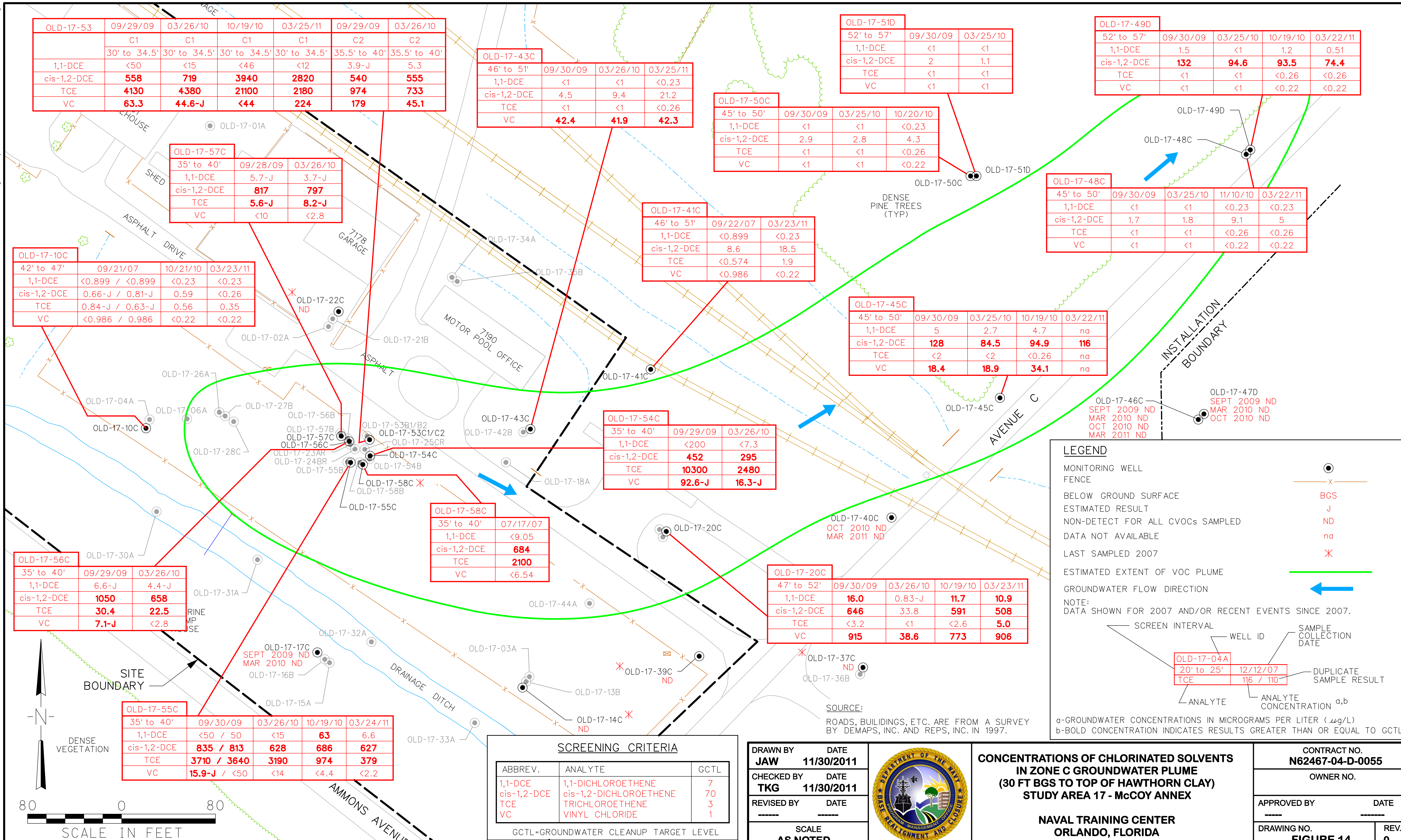
DRAWN BY JAW	DATE 11/30/2011
CHECKED BY TKG	DATE 11/30/2011
REVISED BY ------	DATE ------
SCALE AS NOTED	

CONCENTRATIONS OF CHLORINATED SOLVENTS IN ZONE B GROUNDWATER PLUME (15 TO 30 FT. BGS)
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER ORLANDO, FLORIDA

CONTRACT NO. N62467-04-D-0055	
OWNER NO.	
APPROVED BY -----	DATE -------
DRAWING NO. FIGURE 13	REV. 0

FORM CADD NO. SDIV-BH.DGN - REV 2 - 10/23/03



OLD-17-53	09/29/09	03/26/10	10/19/10	03/25/11	09/29/09	03/26/10
	C1	C1	C1	C1	C2	C2
	30' to 34.5'	30' to 34.5'	30' to 34.5'	30' to 34.5'	35.5' to 40'	35.5' to 40'
1,1-DCE	<50	<15	<46	<12	3.9-J	5.3
cis-1,2-DCE	**558**	**719**	**3940**	**2820**	**540**	**555**
TCE	**4130**	**4380**	**21100**	**2180**	**974**	**733**
VC	**63.3**	**44.6-J**	**<44**	**224**	**179**	**45.1**

OLD-17-43C 46' to 51'	09/30/09	03/26/10	03/25/11
1,1-DCE	<1	<1	<0.23
cis-1,2-DCE	4.5	9.4	21.2
TCE	<1	<1	<0.26
VC	**42.4**	**41.9**	**42.3**

OLD-17-51D 52' to 57'	09/30/09	03/25/10
1,1-DCE	<1	<1
cis-1,2-DCE	2	1.1
TCE	<1	<1
VC	<1	<1

OLD-17-49D 52' to 57'	09/30/09	03/25/10	10/19/10	03/22/11
1,1-DCE	1.5	<1	1.2	0.51
cis-1,2-DCE	**132**	**94.6**	**93.5**	**74.4**
TCE	<1	<1	<0.26	<0.26
VC	<1	<1	<0.22	<0.22

OLD-17-50C 45' to 50'	09/30/09	03/25/10	10/20/10
1,1-DCE	<1	<1	<0.23
cis-1,2-DCE	2.9	2.8	4.3
TCE	<1	<1	<0.26
VC	<1	<1	<0.22

OLD-17-57C 35' to 40'	09/28/09	03/26/10
1,1-DCE	5.7-J	3.7-J
cis-1,2-DCE	**817**	**797**
TCE	**5.6-J**	**8.2-J**
VC	<10	<2.8

OLD-17-10C 42' to 47'	09/21/07	10/21/10	03/23/11
1,1-DCE	<0.899 / <0.899	<0.23	<0.23
cis-1,2-DCE	0.66-J / 0.81-J	0.59	<0.26
TCE	0.84-J / 0.63-J	0.56	0.35
VC	<0.986 / 0.986	<0.22	<0.22

OLD-17-41C 46' to 51'	09/22/07	03/23/11
1,1-DCE	<0.899	<0.23
cis-1,2-DCE	8.6	18.5
TCE	<0.574	1.9
VC	<0.986	<0.22

OLD-17-48C 45' to 50'	09/30/09	03/25/10	11/10/10	03/22/11
1,1-DCE	<1	<1	<0.23	<0.23
cis-1,2-DCE	1.7	1.8	9.1	5
TCE	<1	<1	<0.26	<0.26
VC	<1	<1	<0.22	<0.22

OLD-17-45C 45' to 50'	09/30/09	03/25/10	10/19/10	03/22/11
1,1-DCE	5	2.7	4.7	na
cis-1,2-DCE	**128**	**84.5**	**94.9**	**116**
TCE	<2	<2	<0.26	na
VC	**18.4**	**18.9**	**34.1**	na

OLD-17-54C 35' to 40'	09/29/09	03/26/10
1,1-DCE	<200	<7.3
cis-1,2-DCE	**452**	**295**
TCE	**10300**	**2480**
VC	**92.6-J**	**16.3-J**

OLD-17-58C 35' to 40'	07/17/07
1,1-DCE	<9.05
cis-1,2-DCE	**684**
TCE	**2100**
VC	<6.54

OLD-17-56C 35' to 40'	09/29/09	03/26/10
1,1-DCE	6.6-J	4.4-J
cis-1,2-DCE	**1050**	**658**
TCE	**30.4**	**22.5**
VC	**7.1-J**	<2.8

OLD-17-20C 47' to 52'	09/30/09	03/26/10	10/19/10	03/23/11
1,1-DCE	**16.0**	0.83-J	**11.7**	**10.9**
cis-1,2-DCE	**646**	33.8	**591**	**508**
TCE	<3.2	<1	<2.6	**5.0**
VC	**915**	**38.6**	**773**	**906**

OLD-17-55C 35' to 40'	09/30/09	03/26/10	10/19/10	03/24/11
1,1-DCE	<50 / 50	<15	**63**	6.6
cis-1,2-DCE	**835 / 813**	**628**	**686**	**627**
TCE	**3710 / 3640**	**3190**	**974**	**379**
VC	**15.9-J** / <50	<14	<4.4	<2.2

LEGEND

MONITORING WELL
FENCE
BELOW GROUND SURFACE — BGS
ESTIMATED RESULT — J
NON-DETECT FOR ALL CVOCs SAMPLED — ND
DATA NOT AVAILABLE — na
LAST SAMPLED 2007
ESTIMATED EXTENT OF VOC PLUME
GROUNDWATER FLOW DIRECTION

NOTE:
DATA SHOWN FOR 2007 AND/OR RECENT EVENTS SINCE 2007.

SCREEN INTERVAL — WELL ID — SAMPLE COLLECTION DATE

OLD-17-04A	
20' to 25'	12/12/07
TCE	116 / 110

DUPLICATE SAMPLE RESULT
ANALYTE
ANALYTE CONCENTRATION a,b

a-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER (µg/L)
b-BOLD CONCENTRATION INDICATES RESULTS GREATER THAN OR EQUAL TO GCTL.

SOURCE:
ROADS, BUILDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

SCREENING CRITERIA

ABBREV.	ANALYTE	GCTL
1,1-DCE	1,1-DICHLOROETHENE	7
cis-1,2-DCE	cis-1,2-DICHLOROETHENE	70
TCE	TRICHLOROETHENE	3
VC	VINYL CHLORIDE	1

GCTL=GROUNDWATER CLEANUP TARGET LEVEL

DRAWN BY	DATE
JAW	11/30/2011
CHECKED BY	DATE
TKG	11/30/2011
REVISED BY	DATE
------	------
SCALE	
AS NOTED	

DEPARTMENT OF THE NAVY — BASE REALIGNMENT AND CLOSURE — PROGRAM MANAGEMENT OFFICE

CONCENTRATIONS OF CHLORINATED SOLVENTS IN ZONE C GROUNDWATER PLUME (30 FT BGS TO TOP OF HAWTHORN CLAY) STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER ORLANDO, FLORIDA

CONTRACT NO.	
N62467-04-D-0055	
OWNER NO.	
APPROVED BY	DATE
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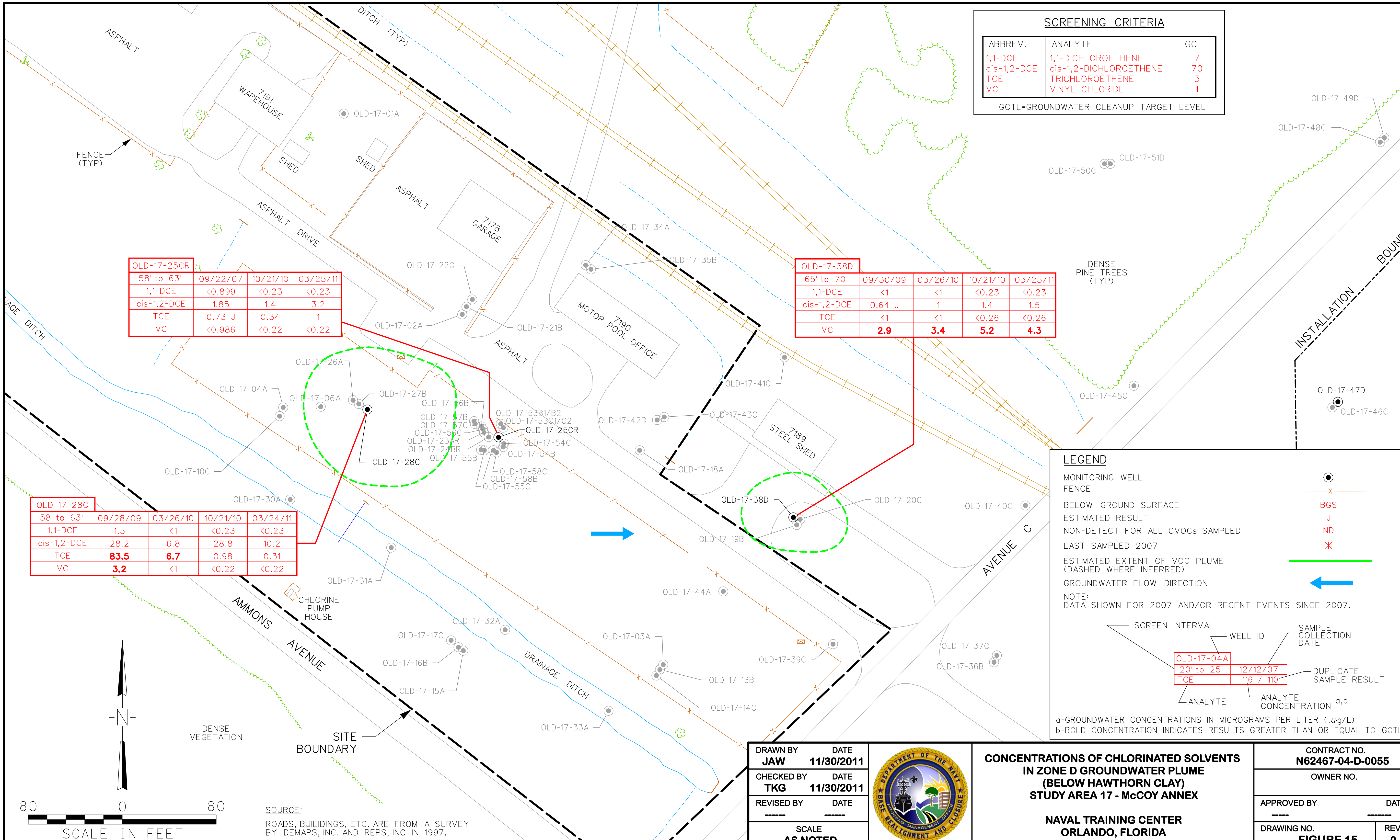
DRAWING NO.	REV.
FIGURE 14	0



SCREENING CRITERIA

ABBREV.	ANALYTE	GCTL
1,1-DCE	1,1-DICHLOROETHENE	7
cis-1,2-DCE	cis-1,2-DICHLOROETHENE	70
TCE	TRICHLOROETHENE	3
VC	VINYL CHLORIDE	1

GCTL=GROUNDWATER CLEANUP TARGET LEVEL

OLD-17-25CR			
58' to 63'	09/22/07	10/21/10	03/25/11
1,1-DCE	<0.899	<0.23	<0.23
cis-1,2-DCE	1.85	1.4	3.2
TCE	0.73-J	0.34	1
VC	<0.986	<0.22	<0.22

OLD-17-38D				
65' to 70'	09/30/09	03/26/10	10/21/10	03/25/11
1,1-DCE	<1	<1	<0.23	<0.23
cis-1,2-DCE	0.64-J	1	1.4	1.5
TCE	<1	<1	<0.26	<0.26
VC	**2.9**	**3.4**	**5.2**	**4.3**

OLD-17-28C				
58' to 63'	09/28/09	03/26/10	10/21/10	03/24/11
1,1-DCE	1.5	<1	<0.23	<0.23
cis-1,2-DCE	28.2	6.8	28.8	10.2
TCE	**83.5**	**6.7**	0.98	0.31
VC	**3.2**	<1	<0.22	<0.22

LEGEND

MONITORING WELL
FENCE
BELOW GROUND SURFACE — BGS
ESTIMATED RESULT — J
NON-DETECT FOR ALL CVOCs SAMPLED — ND
LAST SAMPLED 2007
ESTIMATED EXTENT OF VOC PLUME (DASHED WHERE INFERRED)
GROUNDWATER FLOW DIRECTION

NOTE:
DATA SHOWN FOR 2007 AND/OR RECENT EVENTS SINCE 2007.

SCREEN INTERVAL — WELL ID — SAMPLE COLLECTION DATE

OLD-17-04A	
20' to 25'	12/12/07
TCE	116 / 110

ANALYTE — ANALYTE CONCENTRATION a,b — DUPLICATE SAMPLE RESULT

a-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER (µg/L)
b-BOLD CONCENTRATION INDICATES RESULTS GREATER THAN OR EQUAL TO GCTL.

SOURCE:
ROADS, BUILIDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

DRAWN BY	DATE
JAW	11/30/2011
CHECKED BY	DATE
TKG	11/30/2011
REVISED BY	DATE
------	------
SCALE	
AS NOTED	

DEPARTMENT OF THE NAVY — BASE REALIGNMENT AND CLOSURE — PROGRAM MANAGEMENT OFFICE

CONCENTRATIONS OF CHLORINATED SOLVENTS IN ZONE D GROUNDWATER PLUME (BELOW HAWTHORN CLAY) STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER ORLANDO, FLORIDA

CONTRACT NO. N62467-04-D-0055
OWNER NO.
APPROVED BY ----- DATE -------
DRAWING NO. FIGURE 15 REV. 0

FORM CADD NO. SDIV-BH.DGN - REV 2 - 10/23/03